Programme Structure

Sharda School of Engineering & Technology

Department of Biotechnology

M. Tech – Biotechnology
Programme code: SET0203
(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	18.75%	14	14
Engineering Sciences	81.25%	19	19
Technical and communications skills	18.75%	10	6
Programme Core	62.5%	10	10
Programme Electives	37.5%	23	23
Project(s)	12.5%	52	26

Programme Structure - Department of Biotechnology M.Tech. in Biotechnology

I. Programme Details

Programme Name: M. Tech. Biotechnology Programme Code: SET0203

Programme level : PG
Programme Duration : Two years
Minimum Credits for Programme : 72
Maximum Credits for Programme : 72

Programme Structure with Semester wise Credit distribution Batch: 2023-2025

Programme / Branch: M. Tech. Biotechnology (Bio-Engineering & Bio-Informatics/Genetic Engineering/ Animal Biotechnology/Plant Biotechnology) **Term/Sem.: I** **Session: 2023-24**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1	16994	BTY621	Advanced Biochemistry	4	0	0	4
2	16995	BTY622	Molecular Cell Biology	4	0	0	4
3	16996	BTY623	Advances in Bioprocess Engineering	3	0	0	3
4	16997	BTY624	Applied Genetic Engineering	3	0	0	3
5	16998	BTY625	Enzyme Engineering and Technology	3	0	0	3
6	16999	BTY626	Microbiology	2	0	0	2
PRACTICALS							
7	17000	BTP624	Genetic Engineering and Microbiology Lab	0	0	4	2
TOTAL							**21**

Programme: M. Tech Biotechnology with specialization in Animal Biotechnology **Term/Sem.: II** **Session: 2023-24**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1	17121	BTY639	Animal Transgenic Technology	3	0	0	3
2	17119	BTY637	Immunology and Vaccine Development	3	0	0	3
3	17120	BTY638	Animal Cell Culture Technology	3	0	0	3
4	17129	BTY636	Applied Bioinformatics	3	0	0	3
5	16396	MRM001	Research Methodology	2	0	0	2
6	17118	BTY635	Omics Technologies	4	0	0	4
PRACTICALS							
7	17122	BTP638	Animal Cell culture Technology Lab	0	0	4	2
8	16398	BTP606	Applied Bioinformatics lab	0	0	2	1
9	16119	CCU101	Community connect	0	0	4	2
10	17414	VAT604	Management of Lifestyle Disorders	0	0	0	0
TOTAL							**23**

Programme: M. Tech Biotechnology with specialization in Genetic Engineering **Term/Sem.: II** **Session: 2023-24**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1	17123	BTY640	Transgenic Technology	3	0	0	3
2	17119	BTY637	Immunology and Vaccine Development	3	0	0	3
3	17129	BTY636	Applied Bioinformatics	3	0	0	3
4	16396	MRM001	Research Methodology	2	0	0	2
5	16041	BTY615	Cell and Tissue Engineering	3	0	0	3
6	17118	BTY635	Omics Technologies	4	0	0	4
PRACTICALS							
7	16398	BTP606	Applied Bioinformatics lab	0	0	2	1
8	16040	BTP614	Cell and Tissue Engineering Lab	0	0	4	2
9	16119	CCU101	Community connect	0	0	4	2
10	17414	VAT604	Management of Lifestyle Disorders	0	0	0	0
TOTAL							**23**

Programme: M. Tech Biotechnology with specialization in Bioengineering and Bioinformatics Term/Sem.: II Session: 2023-24

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1	15150	BTY613	Biological Database and their Management	3	0	0	3
2	17129	BTY636	Applied Bioinformatics	3	0	0	3
3	16671	BTY632	Computer Aided Drug Design	3	0	0	3
4	16396	MRM001	Research Methodology	2	0	0	2
5	16041	BTY615	Cell and Tissue Engineering	3	0	0	3
6	17118	BTY635	Omics Technologies	4	0	0	4
PRACTICALS							
7	16040	BTP614	Cell and Tissue Engineering Lab	0	0	4	2
8	16398	BTP606	Applied Bioinformatics lab	0	0	2	1
9	16119	CCU101	Community connect	0	0	4	2
10	17414	VAT604	Management of Lifestyle Disorders	0	0	0	0
TOTAL							**23**

Programme: M. Tech Biotechnology with specialization in Plant Biotechnology **Term/Sem.: II** **Session: 2023-24**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
THEORY SUBJECTS							
1	17129	BTY636	Applied Bioinformatics	3	0	0	3
2	17118	BTY635	Omics Technologies	4	0	0	4
3	17386	BTY644	Plant Molecular Physiology	3	0	0	3
4	17375	BTY641	Plant Tissue Culture and Genetic transformation	3	0	0	3
5	17376	BTY642	Plant Transgenic Technology	3	0	0	3
6	16396	MRM001	Research Methodology	2	0	0	2
PRACTICALS							
7	16398	BTP606	Applied Bioinformatics Lab	0	0	2	1
8	17378	BTP631	Plant Biotechnology Lab	0	0	4	2
9	16119	CCU101	Community connect	0	0	4	2
10	17414	VAT604	Management of Lifestyle Disorders	0	0	0	0
TOTAL							**23**

Programme / Branch: M. Tech. Biotechnology (Bio-Engineering & Bio-Informatics/Genetic Engineering/ Animal Biotechnology/Plant Biotechnology) **Term/Sem.: III** **Session: 2023-24**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
PRACTICALS							
1	17230	BTP625	Seminar	0	0	4	2
2	17231	BTP626	Dissertation-1	0	0	20	10
TOTAL							**12**

Programme / Branch: M. Tech. Biotechnology (Bio-Engineering & Bio-Informatics/Genetic Engineering/ Animal Biotechnology/Plant Biotechnology) **Term/Sem.: IV** **Session: 2022-23**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits
				L	T	P	
PRACTICALS							
1	15358	BTP621	Dissertation-II	0	0	32	16
TOTAL							**16**

	Plant Biotechnology	Animal Biotechnology	Genetic Engineering	Bioengineering and Bioinformatics
Programme Elective 1	Enzyme Engineering & Technology/ Industrial Biotechnology/ Downstream Processing	Enzyme Engineering & Technology/ Industrial Biotechnology/ Downstream Processing	Enzyme Engineering & Technology/ Industrial Biotechnology/ Downstream Processing	Enzyme Engineering & Technology/ Industrial Biotechnology/ Downstream Processing

Programme elective-2	Tolerance to abiotic plant stress/Immunology and Vaccine Development/Molecular Medicine/Protein Engineering/ Biological Database Management	Tolerance to abiotic plant stress/ Plant microbe interaction/ Immunology and Vaccine Development/Molecular Medicine/Protein Engineering/ Biological Database Management	Tolerance to abiotic plant stress/ Plant microbe interaction/ Immunology and Vaccine Development/Molecular Medicine/Protein Engineering/ Biological Database Management	Tolerance to abiotic plant stress/ Plant microbe interaction/ Immunology and Vaccine Development/Molecular Medicine/Protein Engineering/ Biological Database Management

Programme Elective-3	Applied Bioinformatics/ Plant Microbe Interaction/ Metabolic Engineering/ Clinical Biotechnology	Applied Bioinformatics/ Plant Microbe Interaction/ Metabolic Engineering/ Clinical Biotechnology	Applied Bioinformatics/ Plant Microbe Interaction/ Metabolic Engineering/ Clinical Biotechnology	Applied Bioinformatics/ Plant Microbe Interaction/ Metabolic Engineering/ Clinical Biotechnology
Specialization-1	Plant Tissue Culture and Genetic Transformation	Animal Cell culture technology	Cell and Tissue Engineering	Cell and Tissue Engineering
Specialization-2	Plant Transgenic Technology	Animal Transgenic Technology	Transgenic Technology	Computer Aided Drug Design
***** This lab will be offered as Genetic Engineering and Microbiology Lab				

Course Modules

(M. Tech – Biotechnology)

BTY 621: Advanced Biochemistry

School: SSET		**Batch: 2023-25**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 1**	
1	Course Code	BTY 621	
2	Course Title	**Advanced Biochemistry**	
3	Credits	4	
4	Contact Hours (LTP)	4-0-0	
	Course Status	Core	
5	Course Objective	1. Determine structure and functions of polysaccharides, glycoproteins, peptidoglycans, amino acids and lipids. 2. Demonstrate amino acid biosynthesis, fatty acid metabolism and nucleic acid biosynthesis. 3. Analyse role of proteins and metabolites in TCA cycle. 4. Design experiments to demonstrate different steps in photosynthesis, photophosphorylation, photorespiration and oxidative phosphorylation	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Determine. properties of water, essential role of water for life on earth CO2: Evaluate detailed Protein Structure-function relationships: amino acids – structure and functional group properties CO3: Analyse the Glycobiology of Sugars, lipids and its use in physiology CO4: Explanation and analysis of bioenergetics and metabolic process CO5: Characterize the detailed role of Vitamins in cell Metabolism and physiology CO6: Explanation of overall role of Biochemistry in health and disease	
7	Course Description	The course will cover structure and function of biological molecules, protein structure, function and modification, enzyme kinetics, and the study of metabolic pathways and their regulation with a molecular genetics approach	
8	Outline syllabus		CO Mapping
	Unit 1	**Chemical basis of life: Water**	
	A	properties of water, essential role of water for life on earth pH, buffer, maintenance of blood pH and pH of	

		gastric juice, pH optima of different enzymes (pepsin, trypsin and alkaline phosphatase)	CO1, CO6
	B	ionization and hydrophobicity, emergent properties of biomolecules in water	
	C	biomolecular hierarchy, macromolecules, molecular assemblies	
	Unit 2	**Protein structure:**	
	A	Structure-function relationships: amino acids – structure and functional group properties, peptides and covalent structure of proteins, elucidation of primary and higher order structures	CO2, CO6
	B	Ramachandran plot, evolution of protein structure, structure-function relationships in model proteins like myoglobin, hemoglobin, chymotrypsin etc.; Protein folding: Anfinsen's Dogma	
	C	Levinthal paradox, cooperativity in protein folding, free energy landscape of protein folding and pathways of protein folding, molten globule state, chaperons, diseases associated with protein folding, introduction to molecular dynamic simulation.	
	Unit 3	**Glycobiology**	
	A	Sugars-mono, di, and polysaccharides with specific reference to glycogen, amylose, and cellulose	CO3, CO6
	B	glycosylation of other biomolecules-glycoproteins and glycolipids	
	C	lipids- structure and properties of important members of storage and membrane lipids; lipoproteins	
	Unit 4	**Bio-energetics**	
	A	Bioenergetics-basic principles; equilibria and concept of free energy; coupled interconnecting reactions in metabolism; oxidation of carbon fuels; recurring motifs in metabolism	CO4, CO6
	B	Oxidative phosphorylation; importance of electron transfer in oxidative phosphorylation; F1 -F0 ATP Synthase; shuttles across mitochondria; regulation of oxidative phosphorylation	
	C	Photosynthesis – chloroplasts and two photosystems; proton gradient across thylakoid membrane	
	Unit 5	**Role of vitamins & cofactors in metabolism**.	

	A	Role of Vitamins & cofactors in Glycolysis, Gluconeogenesis, Citric Acid Cycle, Fatty Acid biosynthesis and Fatty acid oxidation			CO5, CO6
	B	Amino acids metabolism, nucleotide biosynthesis. Roles of epinephrine and glucagon and insulin in glycogen metabolism			
	C	logic and integration of central metabolism; entry/ exit of various biomolecules from central pathways; principles of metabolic regulation; steps for regulation; starvation responses and insulin signaling.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Nelson D.L. and Cox M.M., "Lehninger Principles of Biochemistry", W.H. Freeman, 2019.			
	Other References	1. Stryer L., "Biochemistry", W. H. Freeman, 2018. 2. Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 2015.			

BTY622: Molecular Cell Biology

School: SSET		**Batch: 2023-25**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 1**	
1	Course Code	BTY 622	
2	Course Title	Molecular Cell Biology	
3	Credits	4	
4	Contact Hours (LTP)	4-0-0	
	Course Status	Core	
5	Course Objective	On successful completion of this module students will be able to: 1. Determine the role of different types of channels associated with trafficking of the molecules. 2. Predict the translocation of biomolecules between different cell organelles 3. Visualize cells and cellular organelles using microscopy. 4. Analyze metabolic activities of a cell and the production of metabolic energy in form of ATP 5. Characterize the functions of nucleus	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Determine different types of cell membrane and their function like translocation of biomolecules thru' membrane. CO2: Determine the types of organelles and their specific function CO3: Analyse the metabolic activity of the cell and protein transport process. CO4: Explanation and analysis of bioenergetics and metabolic process CO5: Characterize the functions of Nucleus and its activities thru' cellular organelles CO6: Explanation of the structure and function of cell organelles	
7	Course Description	Molecular cell biology is a unifying discipline that describes the structure and function of cells in all their genetic, biochemical, developmental, physiological and pathophysiological aspects.	
8	Outline syllabus		CO Mapping
	Unit 1	**Dynamic organization of cell**	
	A	Cell membranes: structure of cell membranes and concepts related to compartmentalization in eukaryotic cells	

	B	Intracellular organelles: endoplasmic reticulum and Golgi apparatus, lysosomes and peroxisomes, ribosomes, cellular cytoskeleton			CO1, CO6
	C	Mitochondria, chloroplasts and cell energetics; nuclear compartment: nucleus, nucleolus and chromosomes			
	Unit 2	**Chromatin structure and dynamics**			
	A	Chromatin organization - histone and DNA interactome: transcriptional initiation, elongation and termination in Eukaryotes; Transcriptional control: promoters and enhancers, transcription factors as activators and repressors, epigenetic factors			CO2, CO6
	B	Post-transcriptional control: splicing and addition of cap and tail, mRNA flow through nuclear envelope into cytoplasm, mechanism of initiation, elongation and termination in Eukaryotes			
	C	Protein translation machinery, ribosomes-composition and assembly; universal and mitochondrial genetic codes, Iso-accepting tRNA			
	Unit 3	**Cellular transport and trafficking**			
	A	Molecular mechanisms of membrane transport, nuclear transport, transport across mitochondria and chloroplasts			CO3, CO6
	B	Intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes/cell exterior			
	C	Co- and post-translational modifications			
	Unit 4	**Cellular processes**			
	A	Cell cycle and its regulation; cell division: mitosis, meiosis and cytokinesis; cell differentiation: cell-ECM and cell-cell interactions			CO4, CO6
	B	cell receptors and transmembrane signaling; cell motility and migration			
	C	Cell death: different modes of cell death and their regulation.			
	Unit 5	**Genome instability and cell transformation**			
	A	Mutations, proto-oncogenes, oncogenes and tumour suppressor genes, physical, intra-genic and inter-genic suppression			CO5, CO6
	B	Role of transposons in genome; viral and cellular oncogenes; structure, function and mechanism of action			
	C	Activation and suppression of tumor suppressor genes; oncogenes as transcriptional activators.			
	Mode of examination	Theory			
		CA	MTE	ETE	

	Weightage Distribution	25%	25%	50%	
	Text book/s*	Gerald K., "Cell and Molecular Biology", John Wiley and Sons, 2006.			
	Other References	1. Cooper G.M., "The Cell: A Molecular Approach", Sinaner Associates, 2004. 2. Verma P.S. and Agarwal, V.K., "Cell Biology, Genetics, Molecular Biology Evolution and Ecology", S. Chand and Company, 2004.			

BTY623 Advances in Bioprocess Engineering

School: SSET		**Batch: 2023-25**
Programme: M.Tech		**Current Academic Year: 2023-24**
Branch: BT		**Semester: I**
1	Course Code	BTY623
2	Course Title	Advances in Bioprocess Engineering
3	Credits	3
4	Contact Hours (LTP)	3-0-0
	Course Status	Core
5	Course Objective	1. To enable students bridge the gap between theoretical concepts and practical aspects in industrial settings 2. In-depth knowledge and hands-on laboratory/industrial skills required for employment or for creation of employment in bioprocess engineering. 3. To enable students about nutritional values and increase yield of products by modifying microorganisms. 4. Knowledge to produce antibiotics, vitamins, vaccines and organic solvents using a bioreactor.
6	Course Outcomes	After successful completion of the course students will be able to- CO1: Able to understand the microbial growth and the effect of different factors on microbial growth. CO2: Design strategies for using bioreactors to address the needs of industry and to conduct scale-up methods for designing bioreactors CO3: Apply the models and mathematical equations to study about the working principles of Bioreactor. CO4: Understand and apply different strategies for the downstream processing to biomolecules at industrial level. CO5: Understand the industrial production of antibiotics, vitamins vaccines and dairy products. CO6: Understand and apply different bioprocess engineering methods and models for the production and optimization of important microbial products.
7	Course Description	The course concentrates on bioprocess engineering and bioreactor operation. A considerable part is devoted to the growth analysis using

		process analytical technology and the evaluation of process data in connection to the generally used cultivation principles.			
8	Outline syllabus				CO Mapping
	Unit 1	**Microbial Growth**			**Unit 1**
	A	Kinetics of cell growth			A
	B	Factors affecting the microbial growth			B
	C	Batch, fed batch and continuous processes			C
	Unit 2	**Design of Bioreactors**			**Unit 2**
	A	Types of bioreactors			A
	B	Design of components of Bioreactor (Main vessel, Sparger and Mixer)			B
	C	Scale-up strategies of bioreactor			C
	Unit 3	**Working of Bioreactor**			**Unit 3**
	A	Heat transfer in CSTR fermentor			A
	B	Mass transfer in CSTR fermentor			B
	C	Monod model			C
	Unit 4	**Downstream Processing**			**Unit 4**
	A	Cell disruption and Product isolation			A
	B	Sedimentation, floatation, adsorption and chromatography			B
	C	Solvent extraction			C
	Unit 5	**Industrial Applications**			**Unit 5**
	A	Industrial production of alcohol, citric acid and amino acids			A
	B	Industrial production of enzymes and antibiotics			B
	C	Fermented dairy products			C
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Doran P.M., “Bioprocess Engineering Principles” Academic Press, 2012.			
	Other References	1. Shuler M.L., “Bioprocess Engineering: Basic Concepts”, Pearson Education, 2012. 2. Najafpour G.D., “Biochemical Engineering and Biotechnology”, Elsevier, 2007.			

BTY624 Applied Genetic Engineering

School: SSET		**Batch: 2023-25**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 01**	
1	Course Code	BTY624	
2	Course Title	**Applied Genetic Engineering**	
3	Credits	5 (Lab + Theory)	
4	Contact Hours (LTP)	3-0-4	
	Course Status	Core	
5	Course Objective	1. To acquire knowledge of principle and techniques involved in genetic engineering. 2. To comprehend the basic strategies of cloning and expression so that may use it for changing the constitution of an organism for human benefit. 3. To know about applications of genetic engineering in industry and health sector	
6	Course Outcomes	CO1: Know and apply the molecular tools, vectors, hosts for genetic manipulation CO2: Comprehend the basic principle of cloning and rDNA technology. CO3: Learn the optimization and technique of DNA amplification by PCR CO4: Analyze gene and protein expression patterns CO5: Create transgenic organisms with desired characteristics using genetic engineering CO6: Understand the basic methods of creating recombinant genes, amplifying the same, creating libraries, engineering proteins and finally apply the knowledge in creating transgenic products with gene delivery tools	
7	Course Description	The course covers fundamentals of genetic engineering that leads to specific advanced applications for the benefit of mankind	
8	Outline syllabus		CO Mapping
	Unit 1	**Enzymes and DNA labelling**	
	A	Restriction Enzymes and their types; Generation of cohesive and blunt ends by restriction enzymes. DNA modifying enzymes: DNA ligase, Klenow Enzyme, T4	CO1, CO6

		DNA Polymerase, Reverse Transcriptase, TdT, phosphatase and other DNA modifying enzymes	
	B	Cohesive and blunt end ligation; Linkers, Adaptors; Homopolymeric tailing	CO1, CO6
	C	Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques	CO1, CO6
	Unit 2	**Vectors for Cloning**	
	A	Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors, Insertion and Replacement vectors	CO2, CO6
	B	Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors--SV-40 & retroviral vectors, Adenovirus based vector	CO2, CO6
	C	Expression vectors: His-tag and GST-tag based vectors, Baculovirus and Pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors	CO2, CO6
	Unit 3	**Steps in Cloning**	
	A	Insertion of foreign DNA into vectors; Cloning using adapters. TA cloning, TOPO-TA cloning, insertion of recombinant DNA into host cells (different strategies of Transformation)	CO3, CO6
	B	Selection of transformants; Construction of genomic DNA and cDNA libraries, Jumping and hopping libraries	CO3, CO6
	C	Screening of libraries by colony hybridization, Screening methods-complementation, insertional inactivation. Screening by PCR, LAMP PCR.	CO3, CO6
	Unit 4	**Gene Expression and *In vitro* DNA Amplification**	
	A	Components of an expression plasmid vector, strategies for codon optimization, optimization of induction of protein expression, inclusion body formation. Methodologies to reduce formation of inclusion bodies	CO4, CO6
	B	Study of Gene Expression, Northern and Western blotting, qPCR, Principles in maximizing gene expression	CO4, CO6
	C	PCR and its types and their applications: factors affecting PCR, primer designing, Gene specific and degenerate primer design, RT PCR, Multiplex PCR, Nested PCR, Inverse PCR, Real-time PCR, TaqMan probe, site directed mutagenesis by PCR, Overlap extension PCR, Chimeric protein engineering by PCR	CO4, CO6
	Unit 5	**Gene targeting and silencing**	
	A	Principle and application of gene silencing; Gene silencing techniques: RNAi, hairpin RNA, siRNA technology;	CO5, CO6

		artificial miRNAs; Construction of siRNA and a miRNA vectors			
	B	Gene replacement; Gene targeting: Mega nucleases, ZFNs, TALENs			CO5, CO6
	C	CRISPR-Cas systems and its various applications			CO5, CO6
	Mode of examination	Theory/Quiz			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	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.			

BTY625 Enzyme Engineering & Technology

School: SSET		**Batch: 2023-25**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 01**	
1	Course Code	BTY625	
2	Course Title	**Enzyme Engineering & Technology**	
3	Credits	3	
4	Contact Hours (LTP)	3-0-0	
	Course Status	Core	
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 Know the Industrial, Research and Therapeutic applications of Enzymes.	
6	Course Outcomes	CO1: Basics of Enzymes and its Classification CO2: Evaluate the role of substrates and cofactors in enzyme kinetics. CO3: Be able to rationally engineer enzymes CO4: Be able to understand principles of enzyme immobilization CO5: Implement the use of enzymes for industrial applications CO6: Be able to apply engineering of enzymes to case studies	
7	Course Description	The course covers fundamentals of genetic engineering that leads to specific advanced applications for the benefit of mankind	
8	Outline syllabus		CO Mapping
	Unit 1	**Enzymes, coenzymes and cofactors**	
	A	Enzymes: Classification, mode of action, activation, specificity, Source of enzymes; production, isolation and purification of enzymes	CO1, CO6
	B	Characterization in terms of pH, temperature, ionic strength, substrate and product tolerance, effects of metal ions; Coenzymes and cofactors	CO1, CO6
	C	Coenzymes, classification of vitamins, role and mechanism of action of some important coenzyme (NAD+/NADP+, FAD, lipoic acid, tetrahydrofolate, B12-coenzyme), role of cofactors with specific examples	CO1, CO6
	Unit 2	**Enzyme kinetics**	
	A	Enzyme as biological catalysts; Enzyme action, active site, functional group, enzyme substrate complex, cofactors,	CO2, CO6

		Michaelis-Menten equation, Km and Vmax, enzyme inhibition; order of reaction, methods of plotting enzyme kinetics data			
	B	Enzyme turnover number. competitive, non-competitive, uncompetitive, irreversible; order of reaction, methods of plotting enzyme kinetics data; determination of Kcat, Km, Vmax, Ki, Half-life, activation and deactivation energy etc,			CO2, CO6
	C	Cross-linked enzyme aggregates, Cross linked enzymes, enzyme crystals, their use and preparation; Enzyme induction, repression, covalent modification, Isoenzymes, allosteric effects			CO2, CO6
	Unit 3	**Enzyme engineering**			
	A	Introduction, Random and rational approach of protein engineering; Enzyme modification and site-directed mutagenesis			CO3, CO6
	B	Chemical modifications of proteins, Directed evolution and its application in Biocatalysis			CO3, CO6
	C	Various approaches of creating variant enzyme molecules.			CO3, CO6
	Unit 4	**Immobilized enzymes**			
	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	Immobilization of multiple enzyme system and immobilized enzymes in industrial processes. Advantages and disadvantages of immobilization; case studies; starch conversion; APA production			CO4, CO6
	C	Biotransformation using soluble as well as immobilized enzymes; Calculation of diffusional resistances and Thiele's modulus, multi-step immobilized enzyme systems			CO4, CO6
	Unit 5	**Applications of enzyme technology**			
	A	Importance of enzymes in diagnostics, Enzyme in organic solvents and ionic liquids: Various organic solvents and ionic liquids used in biocatalysis			CO5, CO6
	B	Potential in organic solvents and ionic liquids; Applications of enzymes in analysis. Use of proteases in food, leather and wool industries, starch hydrolyzing enzymes			CO5, CO6
	C	Uses of lactase in dairy industry, glucose oxidase and catalase in food industry.			CO5, CO6
	Mode of examination	Theory/Quiz			
		CA	MTE	ETE	

	Weightage Distribution	25%	25%	50%	
	Text book/s*	L. Nelson, Michael M. Cox, Lehninger Principles of Biochemistry / Edition 7, Publisher:Freeman, W. H. & Company, 2017			

BTY 626: Microbiology

School: SSET		**Batch: 2023-25**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 1**	
1	Course Code	BTY 626	
2	Course Title	**Microbiology**	
3	Credits	2	
4	Contact Hours (LTP)	2-0-0	
	Course Status	Core	
5	Course Objective	This course is designed with objectives of fundamental aspects of the microbial world on how microbes live, divide and cause diseases. The course will also cover the vast diversity of microbes and how they maintain their genomes	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Determine Morphology, structure, growth and nutrition of bacteria CO2: Evaluate Microbial taxonomy and evolution of diversity CO3: Analyse Sterilization, disinfection and antisepsis: physical and chemical methods for control of microorganisms CO4: Explanation properties of viruses, viral structure, taxonomy of virus, viral replication CO5: Characterize Host-pathogen interaction, ecological impact of microbes; symbiosis CO6: Explanation of overall role of Microbiology in health and disease	
7	Course Description	The course covers microbial characteristics and common infectious agents and the diseases that they cause. The student will be able to evaluate methods used in the clinical microbiology lab and their regulation	
8	Outline syllabus		CO Mapping
	Unit 1	**Microbial characteristics:**	
	A	Morphology, structure, growth and nutrition of bacteria, bacterial growth curve	CO1, CO6
	B	bacterial culture methods; bacterial genetics: mutation and recombination in bacteria,	
	C	plasmids, transformation, transduction and conjugation; antimicrobial resistance	
	Unit 2	**Microbial diversity:**	

	A	Microbial taxonomy and evolution of diversity, classification of microorganisms, criteria for classification; classification of bacteria			CO2, CO6
	B	Cyanobacteria, endospore forming bacteria, Mycobacteria and Mycoplasma.			
	C	Archaea: Halophiles, Methanogens; eukarya: algae, fungi, slime molds and protozoa; extremophiles and unculturable microbes.			
	Unit 3	**Control of microorganisms:**			
	A	Sterilization, disinfection and antisepsis			CO3, CO6
	B	physical and chemical methods for control of microorganisms			
	C	antibiotics, antiviral and antifungal drugs, biological control of microorganisms.			
	Unit 4	**Virology:**			
	A	General properties of viruses, viral structure, taxonomy of virus, viral replication			CO4, CO6
	B	cultivation and identification of viruses; sub-viral particles – viroids and prions. Cellular receptors and virus entry:			
	C	Cellular interactions—clathrin coated pits, lipid rafts, caveolae, endocytosis and virus uncoating mechanisms.			
	Unit 5	**Host-microbes interaction:**			
	A	Host-pathogen interaction, ecological impact of microbes; symbiosis (Nitrogen fixation and ruminant symbiosis)			CO5, CO6
	B	microbes and nutrient cycles; microbial communication system			
	C	bacterial quorum sensing; microbial fuel cells; prebiotics and probiotics.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Hogg S. Essential Microbiology, John Wiley and Sons. Cambridge University Press.2018			
	Other References	Prescott LM, Harley JP, Klein DA. Microbiology, McGraw Hill, 2018			

		Wilson K. and Walker J., “Principles and Techniques of Biochemistry and Molecular Biology”, Cambridge University Press, 2015.	

BTY635 Omics Technologies

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	BTY-635	
2	Course Title	Omics Technology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objective	Understand genome mapping methods and genomic markers RAPD, RFLP, SSR, SNP analyses. Discuss about gene expression analysis, micro array experimental analysis, the identification and analysis of proteins. Understand and discuss the various techniques like MALDI-TOF, Affinity, Ion Exchange, Reversed-phase, and size exclusion.	
6	Course Outcomes	After completion of course the students will be able to: CO1: explain genome mapping methods, SNP analyses, and about markers. CO2: illustrate complex protein mixtures using Nano-liquid chromatography, Bisulfite sequencing,Chromatin accessibility assays. CO3: recall various techniques such as mass spectrometery, MALDI-TOF and LC-MS analyses. CO4: interpret bioinformatic analysis of large-scale microarray data for comparative transcriptomics. CO5: summarize basic aspects of Chain termination and chemical degradation sequencing methods. Genome-wide association (GWA) analysis. CO6: develop an understanding of post-translational modification (PTM) of proteins; Characterization of protein interaction using yeast two-hybrid system and Protein microarrays.	
7	Course Description	The course will help students to acquire a fundamental working knowledge of the genes, proteins, and SNPs to disease-specific in-depth analyses of meta-genetics, protein–protein interactions, modifications, and pathway mapping. Various techniques like MALDI-TOF and LC-MS analyses.	
8	Outline syllabus		CO Mapping
	Unit 1	**Genomics and methods in genomics**	
	A	Genome mapping methods (genetic and physical); RAPD, RFLP, SSR, SNP analyses; Fluorescence *in-situ* Hybridization (FISH) techniques.	CO1, CO6
	B	Advances in gene finding and functional prediction; Chain termination and chemical degradation sequencing methods. Genome-wide	CO1, CO2

		association (GWA) analysis; Comparative Genomic Hybridization (CGH).			
	C	Massively parallel Signature Sequencing (MPSS); Whole genome shot-gun sequencing and its applications; Introduction of Next Generation Sequencing (NGS).			CO1, CO6
	Unit 2	**Transcriptomics and methods in transcriptomics**			
	A	Gene expression analysis by cDNA and oligonucleotide arrays.			CO2, CO1
	B	Micro array experimental analysis and data analysis.			CO2, CO6
	C	Bioinformatic analysis of large-scale microarray data for comparative transcriptomics. RNA-seq.			CO2, CO6
	Unit 3	**Proteomics and methods in proteomics**			
	A	Over-view of strategies used for the identification and analysis of proteins; 2-DE of proteins for proteome analysis; Liquid chromatography separations in proteomics (Affinity, Ion Exchange, Reversed-phase, and size exclusion).			CO3, CO6
	B	Analysis of complex protein mixtures using Nano-liquid chromatography (Nano-LC) coupled to Mass-spectrometry analysis. Introduction to Mass spectrometers; MALDI-TOF and LC-MS analyses.			CO3, CO6
	C	Analysis of post-translational modification (PTM) of proteins; Characterization of protein interactions using yeast two-hybrid system and Protein microarrays.			CO3, CO6
	Unit 4	**Metabolomics and methods in metabolomics**			
	A	Introduction to metabolic engineering, comprehensive models of cellular reactions with stoichiometry and reaction rates.			CO4, CO6
	B	metabolic flux analysis of exactly/over/under determined systems; Shadow price, sensitivity analysis; Monitoring and measuring the metabolome.			CO4, CO6
	C	Methods for the experimental determination of metabolic fluxes by isotope labelling metabolic fluxes using various separation-analytical techniques; GC-MS for metabolic flux analysis.			CO4, CO6
	Unit 5	**Epigenomics and methods in epigenomics**			
	A	High throughput and single cell epigenomics, Histone modification assays: ChIP-Chip and ChIP-Seq. DNA methylation assays.			CO5, CO6
	B	Restriction endonuclease-based methods-Non genome-wide approaches and genome wide approaches.			CO5, CO6
	C	Bisulfite sequencing. Chromatin accessibility assays. Direct detection methods.			CO5, CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Kindt T.J., Osborne B.A. and Goldsby R.A. (2006) Kuby Immunology, W. H. Freeman			

	Other References	Delves P.J, Martin S.J., Burton D.R. and Roitt I.M., (2011) Roitt's Essential Immunology, Wiley Paul B.W.E, "Fundamental Immunology", Lippincott Williams and Wilkins, 2008.	

BTY642- Plant Transgenic Technology

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	BTY642	
2	Course Title	Plant Transgenic Technology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	Discuss about the transgenic plants, health benefits of transgenic plants, production of antibodies and pharmaceuticals in plants. Understanding about genome engineering.	
6	Course Outcomes	CO1. To understand basics of transgenics and plant transformation methods CO2. To learn about selection and analysis of transgenic plants. CO3. To understand about factors influencing transgene expression level CO4. To learn about Gene Editing tools and silencing in plants CO5. To understand various applications of transgenic plants. CO6. To have overall understanding of methods and applications various aspects of plant transgenics in research and industry.	
7	Course Description	The course will help students to understand methodology and applications of transgenic technologies. With step-by-step methods on genome editing techniques and a range of potential applications, improving crop yield.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Transgenic Plants**	
	A	Overview of plant genome and genome engineering	CO1, CO6
	B	Transgenesis, Cisgenesis and intragenesis, Comparison with breeding	CO1, CO6
	C	Plant transformation methods-direct and indirect.	CO1, CO6
	Unit 2	**Selection and analysis of transgenic plants**	
	A	Selectable and reportable markers, Marker free plants, Non-antibiotic based selection.	CO2, CO6
	B	DNA and copy number genotyping (PCR and Southern), RNA- and protein-based conformation (Real-time PCR, Northern, Western, ELISA).	CO2, CO6
	C	Trait stacking in transgenic crops- challenges and opportunities.	CO2, CO6
	Unit 3	**Factors influencing transgene expression level**	
	A	Transcription and translation related issues, PTGS. Co-suppression.	CO3, CO6
	B	Position effect and methods to overcome gene silencing	CO3, CO6
	C	Promoters and other elements to express transgenes.	CO3, CO6
	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			CO4, CO6
	C	Random mutagenesis methods (T-DNA, EMS, transpososns), Transgenic versus genome edited plants.			CO4, CO6
	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, 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.			CO5, CO6
	C	Bio-safety concerns of transgenic plants; Global status of transgenic plants, Regulation and approval of GM Plants.			CO5, CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Neil Stewart 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications, Wiley.			
	Other References	1. Glick, B. R., Pasternak, J. J. (2010). Molecular biotechnology: Principles and applications of recombinant DNA. Washington, D.C: ASM Press. 2. Primrose, S. B., Twyman, R. M., Primrose, S. B., & Primrose, S. B. (2006). Principles of gene manipulation and genomics. Malden, MA: Blackwell Pub. 3. Clarke, A.R. (2002) Transgenesis Techniques Principles and Protocols Editors Springer.			

BTY644 Plant Molecular Physiology

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	BTY644	
2	Course Title	Molecular Plant Physiology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	Discuss about the properties of water, transport processes in plant, photosynthesis Understanding about lipid metabolism in plants, enhancing plant productivity.	
6	Course Outcomes	CO1: illustrate responses of plants to water, plant development. CO2: explain plant growth regulators, nitrogen and sulfur metabolism. CO3: recall biotechnological applications of light signaling in plants. CO4: interpret and analyze different aspects of respiratory metabolisms and plant growth regulations by hormones CO5: summarize photosynthetic processes of plants CO6: develop an understanding of the designing gene constructs.	
7	Course Description	The course will help students to understand plant water relations and transport processes of plants, different aspects of respiratory metabolisms and plant growth regulations by hormones, biotechnological applications by manipulating physiological components.	
8	Outline syllabus		CO Mapping
	Unit 1	**Water relations**	
	A	Properties of water and solutions, cell water potential, soil plant atmosphere continuum.	CO1, CO6
	B	Transport processes in plant: active and passive transport systems, ion channels, driving forces and flow, transport of photo assimilates, transport of proteins and nucleic acids through phloem, phloem loading.	CO1, CO6
	C	Responses of plants to water i.e. drought and flooding and salt-stress, crop improvement for tolerance to water stress and salt stress.	CO1, CO6
	Unit 2	**Photosynthesis:**	
	A	Chlorophylls, Light absorption, emission, energy transfer, Z- scheme of photosynthesis, electron transfer, photophosphorylation.	CO2, CO6
	B	CO2 fixation, C3, C4, CAM plants, environment and its impact on photosynthesis.	CO2, CO6
	Unit 3	**Plant Respiration**	
	A	Enhancing plant productivity by improving carbohydrate metabolism.	CO3, CO6

	B	Plant growth regulators: Auxin, Cytokinins, Gibberellins, Abscisic acid; biosynthesis, homeostasis, transport, and signaling.			CO3, CO6
	C	Plant Hormones: Ethylene, Jasmonic acid, Brassino steroid, Strigolactone; biosynthesis, homeostasis, transport, and signalling. Biotechnological application of hormonal signalling.			CO3, CO6
	Unit 4				
	A	Photoreceptors, Phytochromes, Cryptochromes, phototropins, photo-morphogenesis.			CO4, CO6
	B	plant development. Biotechnological applications of light signalling in plants.			CO4, CO6
	Unit 5	**Mineral nutrition and assimilations of inorganic nutrients**:			
	A	nitrogen and sulfur metabolism, and assimilation of other anions and cations.			CO5, CO6
	B	Lipid metabolism in plants: fatty acid biosynthesis, membrane lipid biosynthesis, lipid desaturation, triacylglycerols, complex lipids.			CO5, CO6
	C	Enhancing plant productivity and alleviation of N and S deficiency, raising plants tolerant to temperature stress by altering membrane lipid saturation.			CO5, CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Taiz, L., Zeiger, P. E. E., Mller, P. E. I. M., & Murphy, P. A. C. A. (2018). Fundamentals of plant physiology. Sinauer Associates. 2. Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants (2nd ed.). Wiley-Blackwell.			
	Other References	Huner, N., & Hopkins, W.. (2013). Introduction to Plant Physiology. (4th ed.) John Wiley & Sons, Inc.			

BTY641 Plant Tissue Culture and Genetic Transformation

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	BTY-641	
2	Course Title	Plant tissue culture and genetic transformation	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	Discuss about the applications of plant tissue culture, protoplast culture, cell suspension culture. Understanding about plant genetic engineering, synthesis of secondary metabolites in plants and agrobacterium biology.	
6	Course Outcomes	CO1: illustrate plant genetic engineering – DNA delivery methods: vector mediated method CO2: explain DNA delivery methods CO3: recall Plant selectable markers; Reporter genes; Transient and stable transformation CO4: interpret various vectors for plant transformation CO5: summarize basic production of alkaloids and other secondary metabolites in plants CO6:develop an understanding of the designing gene constructs.	
7	Course Description	The course will help students to understand lant genetic engineering – DNA delivery methods, applications of plant tissue culture, agrobacterium biology	
8	Outline syllabus		CO Mapping
	Unit 1	**Concepts and techniques in plant tissue culture**	
	A	Tissue culture media; Plant hormones and morphogenesis; Direct and indirect organogenesis; Direct and indirect somatic embryogenesis.	CO1, CO6
	B	Applications of plant tissue culture – Micropropagation of field and ornamental crops; Virus elimination by meristem culture, meristem tip culture and micrografting.	CO1, CO6
	C	Wide hybridization - embryo culture and embryo rescue techniques; Ovule, ovary culture and endosperm culture; Artificial seeds.	CO1, CO6
	Unit 2	***In vitro* culture methods and applications**	
	A	Androgenesis and gynogenesis - production of androgenic and gynogenic haploids - diploidization; Callus culture and *in vitro* screening for stress tolerance and somaconal variation for other useful traits; Large-scale cell suspension culture –Synthesis of secondary metabolites in plants.	CO2, CO6

	B	Production of alkaloids and other secondary metabolites in plants and yeasts, techniques to enhance secondary metabolite production.			CO2, CO6
	C	Protoplast culture - isolation and purification; Protoplast culture; Protoplast fusion; Somatic hybridization - Production of Somatic hybrids,maternal inheritance and cytoplasmic male sterility; Cybrids – Applications; – causes and applications; haploid plants and their uses in biotechnology and plant breeding.			CO2, CO6
	Unit 3	**DNA delivery methods-Agrobacterium**			
	A	Plant genetic engineering – DNA delivery methods: vector mediated method – Agrobacterium tumefaciens and direct DNA delivery methods. Agrobacterium mediated method - Agrobacterium biology.			CO3, CO6
	B	Ti plasmid-based transformation; crown gall and hairy root disease, Ti and Ri plasmids, T-DNA genes, borders, overdrive, chromosomal and Ti plasmid virulence genes and their functions, vir gene induction, mechanism of T-DNA transfer; Ti plasmid vectors, vir helper plasmid, super virulence and monocot transformation.			CO3, CO6
	C	binary vector; genetic engineering of the Ti plasmid (Binary & cointegration), Vectors for chloroplast transformation and their difference from Agrobacterium ones, Cre-Lox system for gene integration.			CO3, CO6
	Unit 4	**DNA delivery methods-Direct DNA delivery methods**			
	A	Protoplasts using PEG; electroporation; laser-based DNA delivery, particle bombardment; Vectors for direct DNA transfer.			CO4, CO6
	B	In planta transformation methods -Floral dip method, Chloroplast transformation, expression using viral vectors.			CO4, CO6
	C	Agroinfiltration approach, Comparison with indirect method.			CO4, CO6
	Unit 5	**Design of gene construct and advanced technologies.**			
	A	Designing gene constructs - Promoters (inducible, constitutive and tissue-specific) and heterologous promoters, polyA signals; Protein targeting signals.			CO5, CO6
	B	Plant selectable markers; Reporter genes; Transient and stable transformation, Making chimeric gene construct, GAL4-UAS enhancer trapping approach.			CO5, CO6
	C	Vectors for plant transformation, Gateway vectors for plant transformation, super binary and ternary vectors.			CO5, CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Adrian S, Nigel WS, Mark RF (2008). Plant Biotechnology: The genetic manipulation of Plants, Oxford University Press. 2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam.The Netherlands.			

	Other References	Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington	

BTY640: Transgenic Technology

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch:		**Biotechnology**	
1	Course Code	**BTY640**	
2	Course Title	**Transgenic Technology**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Semester	2	
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: Understand in vitro regeneration of plants from different explants CO2: Gain knowledge on the production of transgenic plants CO3: Elaborate to the various invitro technology in cloning 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: Acquaint 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			
	Unit 1	**Propagation of Plants**	CO1
	A	History of plant tissue culture, types of media and their preparation	
	B	meristem, callus and suspension cell culture	
	C	protoplast fusion, somaclonal variation, and artificial seeds	
	Unit 2	**Transgenic Plants**	CO2,6

	A	Transgenic crops for tolerance to abiotic stress, engineering crops			
	B	Modern approaches for disease resistance. Cloning plant genes			
	C	Comparative genomics positional cloning-RNAi-mediated crop improvement			
	Unit 3	**In vitro Technology**			CO3
	A	In vitro propagation of cells and development			
	B	Transformation and Transfection in cultured cells			
	C	Application of Invitro technology in Modern genomics			
	Unit 4	**Transgenic Animals**			CO3,4, 6
	A	Cell culture for transgenic animals			
	B	Cloning and recombinant technology for generating transgenic animals			
	C	Transgenic technology in production of human and animal viral vaccines and pharmaceutical proteins			
	Unit 5	**Transgenic Microbes**			CO5,6
	A	expression and tagging of recombinant proteins in E. coli. in S. cerevisiae, Baculovirus overexpression system			
	B	Yeast one-hybrid assay, Yeast two hybrids system			
	C	Significance of transgenic microbes, Production of antibiotics, drugs, vitamins and therapeutic peptides using microbes			
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Transgenesis Techniques Principles and Protocols Editors Alan R. Clarke Springer 2002			
	Other References	Sambrook. E. F. Fritsch and T. Maniatis, "Molecular Cloning: a Laboratory Manual" Cold Spring Harbor Laboratory Press, New York, 2000.			

BTY613: Biological database and their management

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	**BTY613**	
2	Course Title	**Biological database and their management**	
3	Credits	3	
4	Contact Hours (LTP)	3-0-0	
	Course Status	Elective	
5	Course Objective	1. This course surveys a wide range of biological databases and their access tools and enables students to develop proficiency in their use. 2. The course also focuses on the design of biological databases and examines issues related to heterogeneity, interoperability, complex data structures, object orientation and tool integration.	
6	Course Outcomes	CO1: Review different biological databases and web based programming tools to make biological databases accessible. CO2: Develop databases that store biological information (genome sequence database, protein 3D structure database, gene expression profile database, molecular interaction database, etc). CO3: Develop computing tools for analyzing various kinds of biological and experimental data, data mining from databases, computer simulation of living systems and so on. CO4: Develop ontologies necessary for data and knowledge description of databases storing biological functions and integration of the basic databases. CO5: Retrieve and interpret the data from different databanks (nucleotide, cDNA, rRNA, protein sequence, signal peptide and AIDS virus databanks). CO6: Normalize database design and perform experiments using SQL for specifying, authorization, viewing, encryption, structure indexing and hashing. Design and distribute query processing recovery and operate multi database and parallel databases systems.	
7	Course Description	To understand how the database is created and the ways to manage it. Exploring the databases which contains the biological data. It also clears the database design issues and also makes understand the way to protect data	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Databases**	

	A	Data abstraction, Data models, Basic concept of databases, Data independence			CO1
	B	DML, DCL, DDL and structure of database management system			CO1
	C	Entity relationship diagram: Basic and advance concept, Application of ER diagram in designing database system			CO1, CO6
	Unit 2	**Biological Databases I**			
	A	Nucleic acid sequence data banks, Genbank, EMBL, DDBJ			CO2
	B	GenPept, nucleotide sequence databank			CO2
	C	cDNA databank			CO2, CO6
	Unit 3	**Biological Databases II**			
	A	AIDS virus sequence data bank			CO3
	B	rRNA data bank			CO3
	C	Protein sequence data banks, Signal peptide data bank, NBRFPIR, SWISSPROT			CO3, CO6
	Unit 4	**Database Design Issues**			
	A	Normalization INF, 2NF, 3NF, 4NF, BCNF and 5NF			CO4
	B	Database design problems, Security and integrity			CO4
	C	Use of SQL for specifying, authorization, view, encryption, Storage structure indexing and hashing, Different types of file organization			CO4, CO6
	Unit 5	**Distributed Database Structure**			
	A	Design, transparency and autonomy, Distributed query processing recovery			CO5
	B	Commit protocol deadlock handling, Multi database system			CO5
	C	Parallel database concept and related issues, Web interface to database			CO5, CO6
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Cohn R. and Russell J., "Biological Databases", VSD Publications, 2012.			
	Other References	1. Chen J.Y. and Lonardi S., "Biological Data Mining", Chapman and Hall, 2009. 2. Chen J. and Sidhu A.S., "Biological Database Modeling", Artech House, 2007.			

BTY615 Cell and Tissue Engineering

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Biotechnology		**Semester: Even(2nd)**	
1	Course Code	**BTY615**	
2	Course Title	**Cell and Tissue Engineering**	
3	Credits	3	
4	Contact Hours (LTP)	3-0-0	
	Course Status	Elective	
5	Course Objective	1. To Study cell, tissue culture, media component 2. To Study Cell Viability and Kinetics 3. To Study Cell cloning, cell genetics 4. To Study industrial medical and agricultural applications of cell and tissue engineering.	
6	Course Outcomes	After successfully completion of this course students will be able to: 1. Understand basics of Cell and Tissue culture, evaluate media and aseptic techniques of establishing primary and Secondary cell cultures. 2. Understand the concepts and Mechanism of Cell Viability adherence, calculate growth kinetics parameters and apply cryopreservation technique for long term storing of cells. 3. Evaluate Cell Characteristics, Cell Signaling, genetics, establish a continuous cell line from cells of different origin and determine their nutrient and environment requirements 4. Understanding Cell Cloning for Tissue Engineering and Stem Cell Therapy, Biomaterials for Cells 5. Understand Applications of Cell and Tissue Engineering for Industrial , Agriculture medical applications 6. Acquiring Acquaintance of Cell Culture Technology by studying cell, tissue culture, media component, cloning, cell genetics and large scale industrial, agriculture and medical applications of cell and tissue engineering.	
7	Course Description	To acquire a fundamental and advanced knowledge of Cell and Tissue Culture Technology by studying cell, tissue culture, media component, cloning, cell genetics and large scale industrial, agriculture and medical applications of cell and tissue engineering. .	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Cell and Tissue Culture**	CO1,2

	A	History of Cell Culture, Cell, Tissue and organ culture, Culture procedures			CO1
	B	Culture media and growth conditions, primary and Secondary cultures			CO1
	C	Establishment and maintenance of cell lines and Risks in a tissue culture laboratory and safety.			CO2
	Unit 2	**Cell Kinetics and Viability**			CO2,3
	A	Cell cell communication, Characterization of cultured cells morphology of cells			CO2
	B	cell adhesion, proliferation, differentiation, Kinetics involved in growth of cultured cells,			CO2
	C	Cell viability, Methods for testing cell viability, Cytotoxicity assays			CO3
	Unit 3	**Stem Cells and Cell Cloning**			CO3,4
	A	Introduction to Stem Cells and its Types			CO3
	B	Methods of Cloning of Stem Cells			CO3
	C	Stem Cells Applications			CO4
	Unit 4	**Biomaterials for Tissue Engineering**			CO4,5
	A	Biomaterials: Properties Of Biomaterials, Surface, Bulk, Mechanical And Biological Properties			CO4
	B	Types of Biomaterials, Biological and Synthetic Materials, Biopolymers			CO4
	C	Applications Of Biomaterials, Modifications of Biomaterials, Role Of Nanotechnology.			CO5
	Unit 5	**Applications of Cell and Tissue Engineering**			CO5,6
	A	Industrial applications of Cell and Tissue Engineering			CO5,6
	B	Medical Industrial applications of Cell and Tissue Engineering			CO5,6
	C	Food and Agriculture Industrial applications of Cell and Tissue Engineering			CO5,6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Butler M., "Animal Cell Culture and Technology", Garland Science, 2008. Bhojwani S.S., Dantu P.K., "Plant Tissue Culture: An Introductory Text", Springer, 2013.			
	Other References	Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005.			

BTY636 Applied Bioinformatics

School: SSET		**Batch: 2023-2025**
Programme: M.Tech		**Current Academic Year: 2023-24**
Branch: Biotechnology		**Semester: 02**
1	Course Code	**BTY636**
2	Course Title	**Applied bioinformatics**
3	Credits	3
4	Contact Hours (LTP)	3-0-0
	Course Status	Core
5	Course Objective	**1.** To acquire an advanced knowledge of bioinformatics tools used for designing and analyzing in silico experiments and different techniques. **2.** To attain knowledge about data storage model, retrieval of information and integration. To learn the procedure of sequence alignment and phylogenetic analysis by using different online and offline tool along with their algorithms. **3.** To understand about gene organization, genome sequencing, gene prediction methods and motif search methods. To have a clear cut idea about bioinformatics scope, concepts and major databases/tools/softwares with their algorithms used for various application
6	Course Outcomes	CO1: Analyze sequence similarity search using BLAST. CO2: Examine phyolgenetic relationship using clustal and parsimony. CO3: Assess motif consensus by Markov model. CO4: Identify regulatory sequence by Meme. CO5: Determine structure of biomolecules by software (Pymol, Rasmol) and database. CO6: Compute structure of biomolecules using modeling and docking. Perform microarray and protein array analysis for drug target identification and gene prediction.
7	Course Description	To acquire a fundamental knowledge of basic computational biology by studying, designing and analyzing *in silico* experiments. To learn the procedure of sequence alignment and its application in molecular

		phylogenetics. To understand different techniques used for gene prediction and creation of biological databases.			
8	Outline syllabus				CO Mapping
	Unit 1	**Sequence alignment Related Problems**			
	A	Sequence databases, Similarity matrices, pairwise alignment, BLAST			CO1
	B	Sequence assembly, multiple sequence alignment			CO1
	C	Clustal, phylogenetics: distance based approaches, parsimony			CO1, CO6
	Unit 2	**Pattern Analysis in Sequences**			
	A	Motif representation: consensus, regular expressions, Markov model			CO2
	B	Regulatory sequence identification using Meme			CO2
	C	Gene finding: composition based finding, sequence motif based finding			CO2, CO6
	Unit 3	**Structure related Problems I**			
	A	Representation of molecular structures (DNA, mRNA, protein), secondary structures, domains and motifs			CO3
	B	Visualization software (Pymol, Rasmol)			CO3
	C	Experimental determination of structures (Xray crystallography, NMR), Structure databases			CO3, CO6
	Unit 4	**Structure related Problems II**			
	A	Ab initio structure prediction: force fields, backbone conformer generation by Monte Carlo approaches			CO4
	B	Protein structure prediction by comparative modeling approaches (homology modelling, threading)			CO4
	C	Protein ligand docking, Computer aided drug design (pharmacophore identification), QSAR			CO4, CO6
	Unit 5	**Systemwide Analysis**			
	A	Transcriptomics			CO5
	B	Microarray technology, expression profiles, data analysis, SAGE			CO5
	C	Protein arrays, Metabolomics: ^{13}C NMR based metabolic flux analysis			CO5, CO6
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Jin X., "Essential Bioinformatics", Cambridge University Press, 2006.			

	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", WileyInterscience, 2004. 3. Bourne P.E., Gu J., "Structural Bioinformatics", WileyBlackwell, 2009.	

BTY637 Immunology and Vaccine Development

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	**BTY637**	
2	Course Title	**Immunology and Vaccine Development**	
3	Credits	3	
4	Contact Hours (LTP)	3-0-0	
	Course Status	Elective	
5	Course Objective	1. Understand anatomy of immune system, immunity and molecular basis of various immune responses. 2. Discuss about the structure and function of antibody and MHC. 3. Understand and discuss the various immuno techniques, immunization and vaccines.	
6	Course Outcomes	CO1: Describe immune system, immunity and immune responses CO2: Explain structure and function of antibodies, BCR, TCR and MHC; AgAb reaction CO3: Discuss about the molecular basis of immune response. CO4: Explain various techniques in immunology. CO5: Demonstrate the principle behind the immnunization; vaccine and its types. CO6: Explain the organization and functioning immune system, immunity, vaccine, vaccination and immunological techniques.	
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	**Anatomy of Immune System**	
	A	Cell mediated and humoral immunity; Innate and acquired immunity	CO1, CO6
	B	Complement and inflammatory responses	CO1, CO6
	C	Hematopoiesis and origin of primary and secondary lymphoid organs	CO1, CO6
	Unit 2	**Antibody and MHC**	
	A	Structure and function of immunoglobulins	CO2, CO6
	B	Major histo compatibility complex and Complement system	CO2, CO6
	C	BCR, TCR and antigen antibody reaction	CO2, CO6
	Unit 3	**Molecular Basis of Immune Response**	
	A	Activation of T lymphocytes and B lymphocytes	CO3, CO6

	B	Cell mediated, antibody mediated and macrophage mediated cytotoxicity			CO3, CO6
	C	Cytokine release and their role in immune regulation			CO3, CO6
	Unit 4	**Techniques in Immunology**			
	A	RIA and types of ELISA			CO4, CO6
	B	Immunofluorescence and immunoelectron microscopy			CO4, CO6
	C	CMI Techniques			CO4, CO6
	Unit 5	**Vaccinology**			
	A	Vaccination and types of vaccines			CO5, CO6
	B	Recombinant DNA and protein based vaccines, peptide and conjugate vaccines			CO5, CO6
	C	Antibody engineering, catalytic antibody and generation of immunoglobulin gene libraries			CO5, CO6
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Kindt T.J., Osborne B.A. and Goldsby R.A. (2006) Kuby Immunology, W. H. Freeman			
	Other References	1. Delves P.J, Martin S.J., Burton D.R. and Roitt I.M., (2011) Roitt's Essential Immunology, Wiley 2. Paul B.W.E, "Fundamental Immunology", Lippincott Williams and Wilkins, 2008.			

BTY639 Animal Transgenic Technology

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	BTY639	
2	Course Title	Animal Transgenic Technology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	Discuss about the animal viral vectors and other vectors, production of transgenic animals. Understanding about transgenic markers and screening of transgenesis,and production of useful proteins and other products in transgenic animals.	
6	Course Outcomes	CO1: explain production of transgenic animals. CO2: recall genome editing technology CO3:illustrate animal genome engineering. CO4: interpret various Engineering techniques for disease resistance. CO5: summarize basic aspects of production of useful proteins and other products in transgenic animals. CO6:develop an understanding of the Selectable and reportable markers.	
7	Course Description	The course will help students to understand about animal genome engineering, production of transgenic animals and application of transgenic animals.	
8	Outline syllabus		CO Mapping
	Unit 1	**Vectors and design of gene constructs.**	
	A	Animal viral vectors and other vectors and artificial chromosomes used in transgenic production.	CO1, CO6
	B	Promoters, heterologous promoters, polyA signals; Protein targeting signals; Plant selectable markers; Reporter genes.	CO1, CO6
	C	Transient and stable transformation, Making chimeric gene construct, Vector design for transgene expression.	CO1, CO6
	Unit 2	**Animal transgenesis**	
	A	Mechanism of transferring genes into specific animal tissues and cell lines.	CO2, CO6
	B	Methods of transgenesis through gonads, gametes, transposon, retrovirus-mediated, through fertilized eggs or embryos, Stem cell mediated gene transfer, Somatic cell gene transfer.	CO2, CO6

	C	Production of transgenic animals (cattle, mice, sheep, goat, pig and fish) and chimeras. Artificial insemination and embryo transfer. Transgenic manipulation of animal embryo.			CO2, CO6
	Unit 3	**Animal genome engineering**			
	A	All methodologies from random mutagenesis to the targeted mutagenesis,Transposons and virus-mediated insertional mutagenesis, chemical mutagenesis.			CO3, CO6
	B	ZFNs, TALENS and CRISPR-edited transgenic animals. Gene silencing approaches-RNAi, antisense, *Antisense* peptide nucleic acids (*PNAs*).			CO3, CO6
	Unit 4	**Transgenic markers and screening of transgenesis**			
	A	β-galactosidase, firefly luciferase, secreted placental alkaline phosphatase and green fluorescent protein (GFP) as markers, selection markers.			CO4, CO6
	B	Analysis of transgene integration and copy number-PCR-based genotyping, Southern.			CO4, CO6
	C	Evaluation of transgene expression-Northern Western blotting and ELISA for transgene detection and expression.			CO4, CO6
	Unit 5	**Application of transgenic animals**			
	A	Production of useful proteins and other products in transgenic animals (production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins).			CO5, CO6
	B	Transgenic animals for disease resistance and increasing fecundity vaccine and toxicity testing.			CO5, CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Animal Biotechnology-M.M. Ranga, Agrobios, 2000.			
	Other References	Animal Transgenisis and Cloning.Edited by L.M.Houdebine,Wiley,USA			

BTY638-Animal Cell Culture Technology

School: SSET		**Batch: 2023-2025**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	BTY638	
2	Course Title	Animal Cell Culture Technology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	This course will result in understanding of 1. Students will understand gene transfer technologies for animals and animal cell lines 2. To impart the knowledge on basic tissue culture techniques; 3. To apply the state of art knowledge of subject for the production of transgenic animals and production modern drug delivery or vaccination methods.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: recall the history of animal cell culture and basic requirements of animal cell culture laboratory CO2: explain types of animal cell culture media and primary cell culture techniques CO3: identify processes in maintenance of cell lines and their characterization CO4: categorize methods and equipments related to scale up of animal cell culture. CO5: determine applications of animal cell culture CO6: elaborate methods of cell culture and their applications in field of biotechnology	
7	Course Description	This course provides a brief understanding about the animal cell techniques, their set up requirements, scale up and their applications in various fields.	
8	Outline syllabus		CO Mapping
	Unit 1	**Animal Cell Culture: History and Requirements**	CO1, CO6
	A	Introduction, importance, and history of cell culture development	CO1
	B	Designing of an animal cell culture laboratory and biosafety levels	CO1
	C	Equipments needed for animal cell culture laboratory: ; Laminar flow; CO_2 incubator; Refrigerators and freezers; Centrifuge; Inverted stage microscope; Liquid nitrogen freezers; and culture vessels for animal cell culture	CO1, CO6
	Unit 2	**Animal Cell Culture Media and Primary Culture**	CO2, CO6
	A	Media and reagents for cell culture: Types of media; media ingredients, buffering systems and Serum supplemented media	CO2
	B	Introduction to different types of cell cultures: Primary and secondary cell culture; cell lines: finite vs infinite; Three dimensional cell culture: histotypic, oragnotypic and organ culture	CO2

	C	Primary cell culture techniques: Methods of tissue disaggregation (mechanical and enzymatic) and establishment of primary cell culture			CO2, CO6
	Unit 3	**Maintenance of Cell Lines**			CO3, CO6
	A	Basic outline of cell line maintenance: thawing, passaging, and cryopreservation of cell lines; Determination of cell viability and cell counting under haemocytometer; growth curve of cell lines			CO3
	B	Characterization of cell lines			CO3
	C	Common contamination found in cell lines and their eradication			CO3, CO6
	Unit 4	**Scale Up of Animal Cell Culture**			CO4
	A	Scale up in suspension culture: Stirred and static suspension cultures, factors in scaling up; continuous flow culture,			CO4
	B	stirrer culture; continuous flow culture; air-lift fermenter culture			CO4
	C	Scale up in monolayer using Roller bottle culture, multi-surface culture, multi-array disks, spirals and tubes			CO4, CO6
	Unit 5	**Applications of Animal Cell Culture**			CO5, CO6
	A	Application of animal cell culture for in vitro testing of drugs: various cytotoxicity assays and their interpretation			CO5
	B	Study of apoptosis in cell lines: Use of flowcytometry based assays to ascertain aopotosis			CO5
	C	Stem cell culture and applications of stem cell in medicine; application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Freshney I. Culture of Animal Cells: A Manual of Basic Technique, 5th Edition Publisher: Wiley-Liss, 2005 ISBN: 0471453293			
	Other References	Nigel Jen, Animal Cell Biotechnology: Methods and protocols, Humana Press			

BTY 632 Computer Aided Drug Design

School: SSET		**Batch: 2023-25**	
Programme: M.Tech		**Current Academic Year: 2023-24**	
Branch: Genetic Engineering		**Semester: II**	
1	Course Code	BTY 632	
2	Course Title	Computer Aided Drug Design	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	Upon completion of this syllabus, the student can able to understand 1. Role of Bioinformatics/Chemo-informatics in drug designing and discovery process. 2. Different CADD techniques and their importance and applications. 3. Various strategies to design and develop the drug-like/lead-like molecules.	
6	Course Outcomes	CO1: To understand the basics of bioinformatics, chemo-informatics and how useful for drug designing and discovery process. CO2: Acquire the knowledge about protein structure prediction methods, structure visualizations and their importance. CO3: Understand the principle, types and various applications of computer aided drug designing and discovery process. CO4: Explore the concept and SAR, QSAR and their importance in ligand optimization. CO5: Understand the principle and applications of molecular dynamics simulation. CO6: Overall understanding the concept and applications for computer aided drug designing and discovery process.	
7	Course Description	This syllabus covers the various components of computer aided drug designing and discovery process namely protein structure preparation, ligand structure preparation, structural databases, virtual screening techniques, SAR/QSAR, molecular mechanics and molecular dynamics simulation.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	CO1, CO6
	A	History of drug design, Stages of drug discovery and development; Drug properties, likeness; Role of Bioinformatics and Chemo-informatics;	CO1
	B	Classification of Protein Structures – Primary, Secondary, Super-secondary, Tertiary and Quaternary; Active Sites; Allosteric Sites; Domains; Fold; Motif	CO1
	C	Structural databases- PDB, PDBSUM, SCOP, CATH; Chemical and Drug Molecule Databases – PubChem, Zinc	CO1, CO6

		and DrugBank			
	Unit 2	**Preparation of Protein Structure**			CO2, CO6
	A	Introduction to *in silico* and experimental protein structure determination methods;			CO2
	B	*In silico* Structure Prediction - Homology Modeling; Threading; Fold Recognition. Ab initio modeling;			CO2
	C	Model refinement and validation; Prediction of Binding site; Structure Visualization and Analysis tools.			CO2, CO6
	Unit 3	**High throughput Virtual Screening and Molecular Docking**			CO3, CO6
	A	Types of Virtual Screening methods; Structure Based Virtual Screening; Ligand Based Virtual Screening			CO3
	B	Library design; Concept of pharmacophore mapping and pharmacophore based Screening;			CO3
	C	Molecular Docking: Rigid and Flexible docking; Analysis of Protein-Ligand interactions.			CO3, CO6
	Unit 4	**Quantitative Structure Activity Relationship (QSAR)**			CO4
	A	SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters,			CO4
	B	experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant.			CO4
	C	Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.			CO4, CO6
	Unit 5	**Molecular Mechanics and Molecular Dynamics Simulations**			CO5, CO6
	A	General features of molecular mechanics; Energy Minimization - local and global energy minima, saddle point, applications.			CO5
	B	Molecular dynamics simulation			CO5
	C	Understanding the structural stability of protein and protein-ligand complex.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Lednicer, D. (1998) "Strategies for Organic Drug Discovery Synthesis and Design"; Wiley International Publishers.			
	Other References	Andrew R. Leach (2001). Molecular Modeling – Principles and Applications. Second Edition, Prentice Hall, USA			