Program and Course Structure

School of Engineering Technology

M. Tech – Biotechnology
Program code: SET0203
Batch: 2020-2022

1. Standard Structure of the Program at University Level

1.1 Vision, Mission and Core Values of the University

Vision of the University

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

Mission of the University

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

Core Values

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

Vision of the School

To become a globally acclaimed institution of higher learning in engineering and technology promoting excellence in research, innovation and entrepreneurship to provide sustainable solution to the needs of the society

Mission of the School

1. **To impart quality education with strong industry & academic connectivity in the expanding fields of Engineering and Technology in a conducive and enriching learning environment.**
2. **To produce technocrats equipped with technical & soft skills and experiential learning required to stay current with the modern tools in emerging technologies to fulfill professional responsibilities and uphold ethical values.**
3. **To inculcate a culture of interdisciplinary research, innovation and entrepreneurship to provide sustainable solutions to meet the growing challenges and societal needs.**
4. **To foster collaborative learning and to play adaptive leadership role in professional career and pursuit of higher education through effective mentoring and counseling.**

1.2.1Vision and Mission of the Department

Vision of the Department

To serve the society by being a global centre of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship to cater to the needs of biotechnology in health, agriculture and environment sectors.

Mission of the Department

M1: To conduct cutting edge multidisciplinary original research in plant, animal, medical, industrial and environmental biotechnology.

M2: To train and transform students into thinking bioengineers, and scientists who are able to integrate theoretical knowledge with practical applications in diverse areas of Biotechnology

M3: To adapt and update with rapidly changing technologies through self-improvement with continuous learning and education, without compromising with moral and professional ethics.

M4: To provide opportunities for collaborative learning beyond classrooms, in the broader community across the diverse spectrum of disciplines.

1.3 Program Educational Objectives (PEO)

1.3.1 Writing Program Educational Objectives (PEO)

The Educational Objectives of PG Program in Animal Biotechnology are:

PEO1: Post Graduates will be able to integrate the biological sciences with engineering principles for the study of biological systems and medical health related problems.

PEO2: Post Graduates will demonstrate the applications of bioengineering principles through development of industrial designs and processes that are of societal and industrial importance.

PEO3: Post Graduates will update their knowledge and skill set with recent discoveries through self improvement, research experience and continuous learning to create engineering solutions for society and environment.

PEO4: Post Graduates will develop communication skills and demonstrate independent thinking, analytical and problem solving skills, self management and function effectively in team oriented and open ended activities in an industrial or academic environment.

PEO5: Post Graduates will develop leadership skills at levels appropriate to their experience and perform ethically and professionally in business, academia, industry and society.

Methods of Forming PEO's

STEP 1: The needs of the Nation and society are identified through scientific publications, industry interaction and media.

STEP 2. Taking the above into consideration, the PEOs are established by the Coordination Committee of the department.

STEP 3. The PEOs are communicated to the alumni and their suggestions are obtained.

STEP 4. The PEOs are communicated to all the faculty members of the department and their feedback is obtained.

STEP 5. The PEOs are then put to the Board of Studies of the department for final approval.

1.3.2 Map PEOs with School Mission Statements:

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

Enter correlation levels 1, 2, or 3 as defined below:

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

1.3.2.1 Map PEOs with Department Mission Statements:

PEO Statements	Department Mission 1	Department Mission 2	Department Mission 3	Department Mission 4
PEO1:	**3**	**3**	**2**	**1**
PEO2:	**2**	**3**	**1**	**3**
PEO3:	**1**	**2**	**3**	**3**
PEO4:	**1**	**3**	**3**	**2**
PEO5:	**2**	**3**	**3**	**1**

Enter correlation levels 1, 2, or 3 as defined below:

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

1.3.3 Program Outcomes (PO's)

PO1: **Engineering knowledge**: Apply the knowledge of engineering fundamentals, biological and physical sciences to the solution of complex engineering problems.

PO2: **Problem analysis**: Identify and analyze complex engineering problems, formulate research solutions and reach substantiated conclusions using principles of basic and applied sciences and related technologies.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems**: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and bioinformatics tools including prediction and modelling to study complex biological systems with an understanding of the limitations.

PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Lifelong learning**: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PSO1: Acquire practical knowledge of animal system and related techniques to study life processes and apply the knowledge for research and industrial applications.

PSO2: Ability to unravel metabolic and molecular pathways in animal cells and harness or manipulate them for human health and industrial products.

PSO3: Develop understanding of recent research events through self learning and awareness in biotechnology and apply the acquired concepts for industrial purpose.

PSO4: Conduct safe research and learn sustainable product development without compromising environmental safety and ethics.

1.3.4 Mapping of Program Outcome Vs Program Educational Objectives

Mapping	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	3	2	1	1
PO2	3	1	1		
PO3	1	3	2	1	1
PO4	3	2	1	1	
PO5	3	3	2	1	
PO6	1	1	2	2	3
PO7	1	2	3		
PO8				1	3
PO9				3	2
PO10				3	2
PO11	2	3	1	2	3
PO12	2	1	3	1	2
PSO1	3	3	3		
PSO2	3	3	3		
PSO3	1	1	3	1	1
PSO4	1	1	3		3

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

1.3.5 The components of the curriculum

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total number of credits
Basic Sciences	3.75%	6	6
Engineering Sciences	9.06%	22	14.5
Humanities and Social sciences	3.12%	5	5
Technical and communications skills	10%	29	16
Sciences	13.4%	26	21.5
Program Core	27.5%	51	44
Program Electives	13.1%	21	21
Open Electives	6.8%	11	11
Project(s)	13.1%	36	21

School of Engineering and Technology
M. Tech in Biotechnology
Batch: 2020-2022
TERM: I

S. No.	Course Code	Course	Teaching Load			Credits
			L	T	P	
THEORY CLASSES						
1.	BTY601	Analytical Instruments for Biotechnology	3	1	0	4
2.		Elective1	3	0	0	3
3.		Elective2	3	0	0	3
4.		Elective3	3	1	0	4
5.	BTY605	Molecular Cell Biology	3	0	0	3
PRACTICALS						
6.	BTP615	Enzyme & Genetic Engineering Lab	0	0	4	2
7.	BTP605	Molecular Cell Biology Lab.	0	0	4	2
TOTAL CREDITS						**21**

School of Engineering and Technology
M Tech in Biotechnology
Batch: 2020-2022
TERM: II

S. No.	Subject Code	Subjects	Teaching Load			Credits
			L	T	P	
THEORY CLASSES						
1	BTY613	Biological database and their management	3	0	0	3
2		Elective4	3	1	0	4
3		Elective5	3	1	0	4
4		Elective6	3	0	0	3
5		Elective7	3	0	0	3
6	MRM001	Research Methodology (MOOC)	2	0	0	2
PRACTICALS						
7	BTP606	Applied Bioinformatics Lab.	0	0	2	1
8	BTP630	Cell and Tissue Engineering Lab.	0	0	2	1
9	CCU101	Community Connect	0	0	4	2
					TOTAL	**23**

School of Engineering and Technology
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Batch: 2020-2022
TERM: III

S. No.	Subject Code	Subjects	Teaching Load			Credits
			L	T	P	
PRACTICALS						
1	BTP618	Seminar	0	0	4	2
2	BTP620	Dissertation I	0	0	20	10
					TOTAL	**12**

School of Engineering and Technology
M Tech in Biotechnology
Batch: 2020-2022
TERM: IV

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

Syllabus

Prepared by Department of Biotechnology

Core

BTY601 Analytical Instruments for Biotechnology

School: SET		**Batch : 2020-2022**
Program: M Tech		**Current Academic Year: 2020-21**
Branch: Biotechnology		**Semester: 01**
1	Course Code	**BTY601**
2	Course Title	**Analytical Instruments for Biotechnology**
3	Credits	4
4	Contact Hours (LTP)	310
	Course Status	Compulsory
5	Course Objective	To develop and understanding of the principle, instrumentation, operation and applications of different analytical, separation and diagnostic techniques used in the fields of Biochemistry, Molecular Biology and Biotechnology.
6	Course Outcomes	1. Perform experiments based on electrophoretic techniques for separating proteins and nucleic acids. 2. Purify compounds from a mixture using column, ionexchange, affinity chromatography, HPLC, affinity and gas chromatography. 3. Apply the spectroscopy techniques (Absorption and fluorescence, atomic and circular dichroism) to characterize physiochemical properties of biological molecules. Determine structure and mass of organic compounds and proteins by nuclear magnetic resonance (NMR), mass spectrometry and Xray crystallography. 4. Review imaging techniques for disease diagnosis. 5. Illustrate organelle and protein localization by microscopy. Isolate cells by using fluorescence activated cell sorting (FACS) and magnetic activated cell sorting (MACS). Purify proteins by ultrafiltration and dialysis for enzymatic reactions and protein blotting. 6. Relate the basic instrumentation techniques with practical applications for Biotechnology.
7	Course Description	This course will cover the major topics on electrophoretic techniques for separating proteins and nucleic acids, purify compounds from a mixture using column, ionexchange, affinity chromatography, HPLC, affinity and gas chromatography, spectroscopy techniques (Absorption and fluorescence, atomic and circular dichroism) to characterize physiochemical properties of biological molecules, determine structure and mass of organic compounds and proteins by nuclear magnetic resonance (NMR), mass spectrometry and Xray

		crystallography, imaging techniques for disease diagnosis, microscopy, Isolate cells by using fluorescence activated cell sorting (FACS) and magnetic activated cell sorting (MACS), purify proteins by ultrafiltration and dialysis for enzymatic reactions and protein blotting, relate the basic instrumentation techniques with practical applications for Biotechnology.			
8	Outline syllabus				CO Mapping
	Unit 1	**Electrophoresis**			
	A	Principle of electrophoresis (Southern, Northern and Western blotting)			CO1, CO6
	B	Capillary and Immunoelectrophoresis: Principle and applications			CO1, CO6
	C	2Dgel electrophoresis: Principle and applications			CO1, CO6
	Unit 2	**Chromatography**			
	A	Column and ionexchange chromatography			CO2, CO6
	B	Affinity and Gas chromatography: Instrumentation and applications			CO2, CO6
	C	HPLC: Instrument setup and working			CO2, CO6
	Unit 3	**Spectroscopy**			
	A	Raman spectroscopy and NMR: Instrumentation and working			CO3, CO6
	B	Spectrophotometer, ELISA: Instrumentation and working			CO3, CO6
	C	Spectroscopy (Absorption and fluorescence, Atomic spectroscopy), Xray crystallography: crystal preparation, working and uses			CO3, CO6
	Unit 4	**Medical Imaging and Spectrometry**			
	A	Magnetic Resonance Imaging			CO4, CO6
	B	CT, SPECT and PET			CO4, CO6
	C	Instrumentation and working of mass spectrometry			CO4, CO6
	Unit 5	**Techniques in Cell Biology**			
	A	Optical, AFM, Fluorescence and Electron Microscopy			CO5, CO6
	B	Ultracentrifugation, Instrument setup and working of FACS			CO5, CO6
	C	Ultrafiltration and Dialysis			CO5, CO6
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Wilson K. and Walker J., “Principles and Techniques of Biochemistry and Molecular			

		Biology", Cambridge University Press, 2010.	
	Other References	1. Ninfa A.J., Ballou D.P. and Benore M., "Fundamental Laboratory Approaches for Biochemistry and Biotechnology", Wiley, 2009. 2. Sheehan D., "Physical Biochemistry: Principles and Applications", Wiley, 2009.	

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO601.1	3			1					3			3	3	1	2	
CO601.2	3			1					3			3	3	1	3	
CO601.3	3	3	3	2	3				2			2	3		2	
CO601.4	3	3	3	2	3						1	2	3		2	2
CO601.5	3		3	1		2	2		3			3	3	1	3	2
CO601.6	3	3	3	3	3	3	1		3		1	2	3	1	2	1

BTY 605: Molecular Cell Biology

School: SET		**Batch : 2020-2022**	
Program: M.Tech		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 1**	
1	Course Code	BTY 605	
2	Course Title	Molecular Cell Biology	
3	Credits	3	
4	Contact Hours (LTP)	300	
	Course Status	Compulsory	
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 transdport 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	**Molecular Composition of Cell Membrane**	
	A	Lipid structure and fatty acids, phospholipids forming lipid vesicles, membrane proteins , carbohydrate , bacterial outer membrane	

	B	Transport across Cell Membranes ;Ion channels and transport of small molecules, channel proteins, carrier proteins; active and passive transport of molecues, Antiport			CO1, CO6
	C	Endocytosis: Phagocytosis, Receptor mediated Endocytosis			
	Unit 2	**ER & Protein Sorting**			
	A	Endoplasmic Reticulum ; targeting protein to ER; Overview of protein sorting; Isolation of rough ER			CO2, CO6
	B	Protein folding and processing in ER			
	C	Lysosomes			
	Unit 3	**Protein Transport**			
	A	GPI anchors			CO3, CO6
	B	Golgi Apparatus, structure & function			
	C	Protein sorting and export from Golgi, Vesicular transport			
	Unit 4	**Bioenergetics and Metabolism**			
	A	Metabolism in the matrix of Mitochondria: organization and function; Import of mitochondrial matrix protein			CO4, CO6
	B	Chloroplast &plastids; protein import into chloroplast stroma; import of proteins into thyllakoid membrane of chloroplasts;; Electron flow through photo system I and II			
	C	Peroxisomes functions			
	Unit 5	**Internal organization of Nucleus**			
	A	Structure of the nuclear envelop; Nuclear Pore complex			CO5, CO6
	B	Protein transport to and from Nucleus; functional domain within the nucleus			
	C	Cajal bodies ;Nucleolus			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	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.			

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO605.1	3			1					3			3	3	1	2	
CO605.2	3			1					3			3	3	1	3	
CO605.3	3	3	3	2	3				2			2	3		2	
CO605.4	3	3	3	2	3						1	2	3		2	2
CO605.5	3		3	1		2	2		3			3	3	1	3	2
CO605.6	3	3	3	3	3	3	1		3		1	2	3	1	2	1

BTY613:Biological database and their management

School: SET		**Batch : 2020-2022**
Program: M.Tech		**Current Academic Year: 2020-21**
Branch: Biotechnology		**Semester: 02**
1	Course Code	**BTY613**
2	Course Title	**Biological database and their management**
3	Credits	3
4	Contact Hours (LTP)	300
	Course Status	**Compulsory** /Elective/Open 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 webbased 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 multidatabase 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 DatabasesI**			
	A	Nucleic acid sequence data banks, Genbank, EMBL, DDBJ			CO2
	B	GenPept, nucleiotide sequence databank			CO2
	C	cDNA databank			CO2, CO6
	Unit 3	**Biological DatabasesII**			
	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, Multidatabase 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	
		30%	20%	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.			

COURSE ARTICULATION MATRIX

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO613.1	3			1					3			3	3	1	2	
CO613.2	3			1					3			3	3	1	3	
CO613.3	3	3	3	2	3				2			2	3		2	
CO613.4	3	3	3	2	3						1	2	3		2	2
CO613.5	3		3	1		2	2		3			3	3	1	3	2
CO613.6	3	3	3	3	3	3	1		3		1	2	3	1	2	1

Electives

Elective1

BTY604 Advances in Bioprocess Engineering

School: SET		**Batch : 2020-2022**
Program: M. Tech		**Current Academic Year: 2020-21**
Branch: BT		**Semester: I (Odd semester)**
1	Course Code	BTY604
2	Course Title	Advances in Bioprocess Engineering
3	Credits	3
4	Contact Hours (LTP)	300
	Course Status	Compulsory/**Elective**/Open Elective
5	Course Objective	1. To enable students bridge the gap between theoretical concepts and practical aspects in industrial settings 2. Indepth knowledge and handson 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: Apply mathematical models for calculating substrate uptake, product formation and cell kinetics. CO2: Design strategies for using bioreactors to address different needs of the industry and to conduct scaleup 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, and vaccines. 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**			**CO1**
	A	Unstructured and structured models for reactor process			CO1
	B	Mathematical models for substrate uptake and product formation			CO1
	C	Kinetics of cell growth, plasmid stability			CO1
	Unit 2	**Design of Bioreactors**			**CO2**
	A	Types of microbial and enzyme bioreactors			CO2
	B	Batch, fed batch and continuous processes			CO2
	C	Scaleup of reactor			CO2
	Unit 3	**Working of Bioreactor**			**CO3**
	A	Heat transfer and design equations for CSTR fermentor			CO3
	B	Monod model			CO3
	C	Rheology			CO3
	Unit 4	**Downstream Processing**			**CO4**
	A	Cell disruption and solvent extraction			CO4
	B	Product recovery			CO4
	C	Sedimentation, floatation, adsorption and chromatography			CO4
	Unit 5	**Industrial Applications**			**CO5**
	A	Industrial production of alcohol, citric acid, amino acids, enzymes, antibiotics and steroids			CO5
	B	Microbiology of fermented milk			CO5
	C	Tea, coffee and vinegar fermentation			CO5
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	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.	

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO604.1	3			1					3			3	3	1	2	
CO604.2	3			1					3			3	3	1	3	
CO604.3	3	3	3	2	3				2			2	3		2	
CO604.4	3	3	3	2	3						1	2	3		2	2
CO604.5	3		3	1		2	2		3			3	3	1	3	2
CO604.6	3	3	3	3	3	3	1		3		1	2	3	1	2	1

Elective2

BTY603Applied Genetic Engineering

School: SET		**Batch : 2020-2022**	
Program: M.Tech		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 01**	
1	Course Code	BTY603	
2	Course Title	**Applied Genetic Engineering**	
3	Credits	3	
4	Contact Hours (LTP)	300	
	Course Status	Compulsory/**Elective**/Open Elective	
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	**Tools of Genetic Engineering**	
	A	Genetic engineering and molecular tools	CO1, CO6
	B	Enzymes involved in manipulation of genetic material	CO1, CO6

	C	Vectors and host for cloning and cloning process			CO1, CO6
	Unit 2	**Cloning**			
	A	Cloning and Construction of recombinant DNA			CO2, CO6
	B	Cloning interacting genes			CO2, CO6
	C	Library construction and screening			CO2, CO6
	Unit 3	***In vitro* Amplification of DNA**			
	A	Polymerase chain reaction and its types			CO3, CO6
	B	Cloning of genes by PCR			CO3, CO6
	C	Optimization of PCR			CO3, CO6
	Unit 4	**Expression**			
	A	Expression strategies			CO4, CO6
	B	Vector and host engineering			CO4, CO6
	C	Protein engineering and gene tagging			CO4, CO6
	Unit 5	**Applications**			
	A	Strategies of gene delivery			CO5, CO6
	B	Methods for gene expression analysis			CO5, CO6
	C	Transgenic organisms			CO5, CO6
	Mode of examination	Theory/Quiz			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Brown T.A, "Gene Cloning and DNA Analysis: An Introduction", John Wiley & Sons, 2010			
	Other References	1. Old R.W and Primrose S.B., "Principles of Gene Manipulation", Blackwell Scientific Publication, 2002. 2. Dale W., von Schantz M. and Plant N., "From Genes to Genomes: Concepts and Applications of DNA Technology", John Wiley, 2011.			

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO603.1	3			3			3			2		3	3	1		2
CO603.2	2			2			1					1	3	1	3	
CO603.3	2	1			3		1			1		1	2		2	
CO603.4	3	3	3	2	3						1			3	3	2
CO603.5	3		3	1		2	2		3			3	3	1	3	2
CO603.6	3	2	2		3	3	1		3		1	2	3	1	3	1

Elective3

BTY602 Enzyme Technology

School: SET		**Batch : 2020-2022**
Program: M.Tech		**Current Academic Year: 2020-21**
Branch: Biotechnology		**Semester: Odd (1st)**
1	Course Code	**BTY 602**
2	Course Title	**Enzyme Technology**
3	Credits	3
4	Contact Hours (LTP)	300
	Course Status	Compulsory /**Elective**/Open Elective
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 biotransformations 4. Know the Industrial, Research and Therapeutic applications of Enzymes.
6	Course Outcomes	After successfully completion of this course students will be able to: 1. Basics of Enzymes and its Classification 2. Evaluate the role of substrates and cofactors in enzyme kinetics. 3. Predict type of enzyme inhibition by using Lineweaver Burk plot method. 4. Optimize enzyme catalyzed reactions and compare rate of reactions of enzyme catalyzed and noncatalyzed reactions. 5. Perform and analyze enzymatic assays using spectrophotometer and microtiter plate reader. 6. Purify proteins by precipitation and determine protein-protein interaction by coimmunoprecipitation. 7. Purify native enzymes and compare catalytic activity with engineered enzymes. 8. Implement the use of enzymes for industrial applications.
7	Course Description	This course covers fundamentals to applications necessary for the useful exploitation of enzymes both as tools for the enzymatic analyses and as biocatalysts in the biotransformations on the unique structuralfunctional

		properties of enzymes and its industrial and research utilization.			
8	Outline syllabus				CO Mapping
	Unit 1	**Enzymes**			CO1
	A	Classification of enzymes			CO1
	B	Properties of enzymes			CO1,2
	C	Factors affecting enzymatic activity			CO1,2
	Unit 2	**Kinetics of Enzyme Catalyzed Reaction**			CO1,2
	A	Enzymesubstrate complex			CO1
	B	Enzyme inhibition			CO2
	C	Modulation and regulation of enzyme activity			CO2
	Unit 3	**Mechanism of Enzymecatalyzed Reaction**			CO3,4
	A	Mechanism of enzyme action			CO3,4
	B	Coenzymes and cofactors			CO4
	C	Organization of enzymes			CO4
	Unit 4	**Immobilization of Enzymes**			CO 4,5,6
	A	Principle and kinetics of enzyme immobilization			CO4
	B	Multienzyme system			CO 5,6
	C	Industrial processes, utilization and regeneration of cofactors			CO5,6
	Unit 5	**Industrial Uses of Enzymes**			CO6,7,8
	A	Nonrecombinant sources of enzymes			CO6
	B	Impact of genetic engineering on enzyme production			CO7,8
	C	Engineered enzymes			CO6,7,8
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Palmer T., Bonner P. L., “Enzymes: Biochemistry, Biotechnology, Clinical Chemistry”, Woodhead Publishing, 2007.			
	Other References	1. Copeland R. A., “Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis”, Wiley, 2006. 2. Guisán J. M., “Immobilization of Enzymes and Cells (Methods in Biotechnology)”, Humana Press, 2010.			

COURSE ARTICULATION MATRIX

COs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO602.1	3			2					3			3	3	1	2	
CO602.2	3			1					3			2	3	1	1	
CO602.3	3	3	2	1	3				2			2	3		1	
CO602.4	3	3	2	2	3						1	2	3		2	2
CO602.5	3		3	1		2	2		1			2	3	1	2	2
CO602.6	3	3	3	3	3	3	1		3		1	2	3	1	2	1

Elective4

BTY631Molecular Signaling

School: SET		**Batch : 2020-2022**
Program: M.Tech		**Current Academic Year: 2020-21**
Branch: Biotechnology		**Semester: 02**
1	Course Code	**BTY631**
2	Course Title	**Molecular Signaling**
3	Credits	4
4	Contact Hours (LTP)	310
	Course Status	Compulsory /**Elective**/Open Elective
5	Course Objective	1. To understand how communication takes place between different cells in the body. 2. To elucidate the signal transduction pathways involved in several diseases which is important to define the new target for drug development.
6	Course Outcomes	CO1: Determine the types of communication between cells and correlate deregulation of extracellular matrix with occurrence of different diseases. CO2: Analyse the progression of signals inside the cell by identify the role of secondary messengers in signalling pathways. CO3: Perform covalent modification (phosphorylation) by using serine/threonine and tyrosine protein kinases thus understand pathways in cells during different types of stress/ signalling. CO4: Understand the neuronal signalling in correlation with its regulatory pathways. CO5: Demonstrate the role played by tumour suppressor genes and oncogenes thus recognize the roles played by proapoptotic, antiapoptotic proteins and caspases in apoptosis. CO6: To identify the possibilities, efficacy and potency of therapeutic drugs in cell signalling pathways for disease treatments.
7	Course Description	To understand how communication takes place between different cells in the body. To elucidate the signal transduction pathways

		involved in several diseases which is important to define the new target for drug development.			
8	Outline syllabus				CO Mapping
	Unit 1	**Cellular Communication**			
	A	Introduction to cell signalling.			CO1
	B	Intercellular communication and its types			CO1
	C	Extracellular matrix, Neurotransmitters and Neurohormones			CO1, CO6
	Unit 2	**Signal Transduction**			
	A	Receptors and its types.			CO2
	B	Gprotein coupled receptormediated signalling.			CO2
	C	Modulation of different signalling by secondary messengers.			CO2, CO6
	Unit 3	**Protein Kinases and their pathways**			
	A	Classification and regulation of protein kinases. Role of phosphatises and inhibitory proteins.			CO3
	B	Protein Kinase A pathway and Regulation of PI3K/Akt pathway.			CO3
	C	MAPK cascades.			CO3, CO6
	Unit 4	**Siganling in Plants**			
	A	Phytohormones and signaling mechanisms			CO4
	B	Phytochromes and Cryptochrome			CO4
	C	Memory retention in plants.			CO4, CO6
	Unit 5	**Signalling in Cancer**			
	A	Oncogenes and tumour suppressor genes.			CO5
	B	Cancer progression and metastasis.			CO5
	C	Apoptosis and therapeutic intervention for treating cancer.			CO5, CO6
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Krauss G., “Biochemistry of Signal Transduction and Regulation”, WileyVCH, 2008.			
	Other References	1. Hancock J.T., “Cell Signalling”, Oxford University Press, 2010. 2. Gomperts B.D., Kramer I.M. and Tatham P.E.R., “Signal Transduction”, Academic Press, 2009.			

COURSE ARTICULATION MATRIX

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO2 16.1	3	3			1			3			3		3	2		
CO2 16.2	3		3		2	3	3			2				3	3	3
CO2 16.3	3			2	2		3	3		3			2	3		3
CO2 16.4	3	3			2				3		2		3	2		
CO2 16.5	3	3	3		2	3		2				3	3		2	
CO2 16.6	3	3			3	3			3		3		3	3	3	3

Elective5

BTY630 Cell and Tissue Engineering

School: SET		**Batch : 2020-2022**
Program: M.Tech		**Current Academic Year: 2020-21**
Biotechnology		**Semester: Even(2nd)**
1	Course Code	**BTY630**
2	Course Title	**Cell and Tissue Engineering**
3	Credits	4
4	Contact Hours (LTP)	310
	Course Status	Compulsory /**Elective**/Open 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 Therarpy, Biomaterials for Cells 5. Understand Applications of Cell and Tissue Engineering for Industrial , Agriculture medical applications 6. Acquiring Aquaintence 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	cellcell 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	
		30%	20%	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.	

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO615.1	3			1					3			3	3	1	2	
CO615.2	3			1					3			3	3	1	3	
CO615.3	3	3	3	2	3				2			2	3		2	
CO615.4	3	3	3	2	3						1	2	3		2	2
CO615.5	3		3	1		2	2		3			3	3	1	3	2
CO615.6	3	3	3	3	3	3	1		3		1	2	3	1	2	1

Elective6

BTY606 Applied Bioinformatics

School: SET		**Batch : 2020-2022**
Program: M.Tech		**Current Academic Year: 2020-21**
Branch: Biotechnology		**Semester: 02**
1	Course Code	**BTY606**
2	Course Title	**Applied bioinformatics**
3	Credits	3
4	Contact Hours (LTP)	300
	Course Status	Compulsory /**Elective**/Open Elective
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 *insilico* 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	**Sequencealignment 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 motifbased finding	CO2, CO6
	Unit 3	**Structurerelated ProblemsI**	
	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	**Structurerelated ProblemsII**	
	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	Proteinligand docking, Computeraided 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	CO5, CO6

		metabolic flux analysis			
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	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.			

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO606.1	3			1						3		2		1		
CO606.2	3			2								1				
CO606.3	3	3	3	2	3				2			2	3		2	
CO606.4	3	3		3		3				2			3		2	
CO606.5	3	3	3	2	3	3					1	2	3		2	2
CO606.6	3		3	1		2	2		3			3	3	1	3	2

Elective7

BTY607 Immunotechnology

School: SET		**Batch: 2020-2022**	
Program: M.Tech.		**Current Academic Year: 2020-21**	
Branch: Biotechnology		**Semester: 02**	
1	Course Code	**BTY607**	
2	Course Title	**Immunotechnology**	
3	Credits	3	
4	Contact Hours (LTP)	300	
	Course Status	Compulsory /**Elective**/Open 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 immunotechniques, 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	Cellmediated and humoral immunity; Innate and acquired immunity	CO1, CO6
	B	Complement and inflammatory responses	CO1, CO6
	C	Hematopoesis 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 histocompatability complex and Complement system	CO2, CO6
	C	BCR, TCR and antigenantibody reaction	CO2, CO6

	Unit 3	**Molecular Basis of Immune Response**			
	A	Activation of Tlymphocytes and Blymphocytes			CO3, CO6
	B	Cellmediated, antibodymediated and macrophagemediated 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	
		30%	20%	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.			

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO607. 1	3			1						3		2		1		
CO607. 2	3			2								1				
CO607. 3	3	3	3	2	3				2			2	3		2	
CO607. 4	3	3		3		3				2			3		2	
CO607. 5	3	3	3	2	3	3					1	2	3		2	2
CO607. 6	3		3	1		2	2		3			3	3	1	3	2

BTY 632 Computer Aided Drug Design

School: SET		Batch : **2020-2022**	
Program: M Tech		Current Academic Year: 2020-21	
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	DE	
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 and DrugBank			CO1, CO6
	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	
		30%	20%	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	

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO632.1	3			1						3		2		1		
CO632.2	3			2								1				
CO632.3	3	3	3	2	3				2			2	3		2	
CO632.4	3	3		3		3				2			3		2	
CO632.5	3	3	3	2	3	3					1	2	3		2	2
CO632.6	3		3	1		2	2		3			3	3	1	3	2

BTY 633 Animal Cell Technology

School: SET		Batch : **2020-2022**	
Program: M Tech		Current Academic Year: 2020-21	
Branch: Genetic Engineering		Semester: II	
1	Course Code	BTY 633	
2	Course Title	Animal cell Technology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	DE	
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: Demonstrate foundational knowledge of Cell culture techniques and competence in laboratory techniques CO2: Understand various types of media and supplements required for animal cell culture. CO3: Familiarize with basic concept of cell lines, immobilization and maintenance of cell culture. CO4: Understand basic concept of scale up of animal cell culture. CO5: Acquire knowledge in tissue engineering and its applications by various methods CO6: Acquire adequate knowledge in the animal cell culture, genetically modified organisms and their beneficial uses	
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**	CO1, CO6
	A	Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture.	CO1
	B	Advantages and limitations of animal cell culture, genetic engineering of animal cells and their applications.	CO1
	C	Risks in a tissue culture laboratory and safety and biohazards.	CO1, CO6

	Unit 2	**Animal Cell Culture Requirements**			CO2, CO6
	A	Facilities for animal cell culture, infrastructure, equipment, culture vessels.			CO2
	B	Different types of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents			CO2
	C	Biology and characterization of cultured cells, cell adhesion, proliferation, differentiation, morphology of cells and identification.			CO2, CO6
	Unit 3	**Primary cell culture techniques**			CO3, CO6
	A	Mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells, manipulation of cell line selection, types of cell lines, maintenance of cell lines			CO3
	B	immobilization of cells and its application, synchronization of cell cultures and cell division, production of secondary metabolites, biotransformation,			CO3
	C	Induction of cell line mutants and mutations, cryopreservation, germplasm conservation and establishment of gene banks.			CO3, CO6
	Unit 4	**Animal Cell Culture Scale-up**			CO4
	A	Scale up in suspension, stirrer culture, continuous flow culture, air-lift fermenter culture			CO4
	B	Scale up in monolayer using Roller bottle culture, multi-surface culture, multi-array disks, spirals and tubes			CO4
	C	Monitoring of cell growth and cell death.			CO4, CO6
	Unit 5	**Tissue engineering and its applications**			CO5, CO6
	A	Design and engineering of tissues, tissue modeling. Embryonic stem cell engineering, ES cell culture to produce differential cells.			CO5
	B	Human embryonic stem cell research and embryo micromanipulation			CO5
	C	Transgenic animals, and xenotransplantation			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	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			

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO633. 1	3			1						3		2		1		
CO633. 2	3			2								1				
CO633. 3	3	3	3	2	3				2			2	3		2	
CO633. 4	3	3		3		3				2			3		2	
CO633. 5	3	3	3	2	3	3					1	2	3		2	2
CO633. 6	3		3	1		2	2		3			3	3	1	3	2