GANPAT UNIVERSITY									
FACULTY OF ENGINEERING & TECHNOLOGY									
Programme	Bachelor of Technology					Branch/Spec.	Biomedical Engineering		
Semester	VII					Version	1.0.0.0		
Effective from Academic Year			2025-2026			Effective for the batch Admitted in			July 2022
Subject code	2BM71PE01		Subject Name			Elective-III: Tissue Engineering			
Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	-	-	-	3	Theory	40	60	100
Hours	3	-	-	-	3	Practical	-	-	-

Pre-requisites
Good Knowledge of Human Tissues and basic chemistry.

Course Outcomes	
On successful completion of the course, the students will be able to:	
CO1	**Demonstrate** a comprehensive understanding of the fundamentals, motivation, and core components of tissue engineeringg.
CO2	**Analyze** the dynamic cellular processes in tissue engineering.
CO3	**Identify** and **evaluate** natural and synthetic scaffold materials.
CO4	**Examine** the design requirements and functionality of various bioreactor types.
CO5	**Apply** real-world applications of tissue engineering for the development of various organs.
CO6	**Evaluate** clinical trials and translational research involving tissue engineering in various medical fields.

Theory syllabus

Unit	Content	Hrs.
1	INTRODUCTION: Tissue engineering and its fundamentals, Motivation behind tissue engineering, Basic working components of Tissue engineering, Cell sources in tissue engineering, Stem cells: Its types, classification and predominant lineages, Cell seeding processes: Passive and Dynamic methods.	8
2	CELLULAR INTERACTION IN TISSUE ENGINEERING: Tissue organisation and cell types, Dynamic states of Tissue, Cell differentiation, Cell migration, Cell division, cell death or apoptosis, Coordination of cellular-fate processes: soluble signals, Cell-Extracellular Matrix Interactions, Direct cell-cell contact, Cell sorting by FACS.	9
3	SCAFFOLD MATERIALS IN TISSUE ENGINEERING: Natural scaffolds in Tissue engineering, Biomaterials used in Tissue engineering namely: Natural and synthetic polymers - Its basic/ Unit structure, physical properties, degradation behaviour, application; Hydrogels - Its basic structure, physical properties, classification, clinical applications.	8
4	BIOREACTORS AND SCAFFOLD FABRICATION TECHNIQUES: Design requirements of Bioreactors, Types of Bioreactors: Rotating wall, Spinner flask, Direct perfusion, Hollow fiber, Compression and strain type. Basic fabrication Techniques: Solvent-casting and particulate leaching, Gas foaming, Freeze-drying, Melt Molding, Sintering, Electro-spinning, Rapid prototyping (RP) Techniques overview.	12
5	CASE STUDIES OF TISSUE ENGINEERING APPLICATIONS: Tissue engineering used for development of Skin, Cartilage, development of IPS cells from skin cells, application of IPS cells, Heart valves and Blood vessels, clinical trials for Liver Tissue Engineering & Artificial pancreas.	8

Practical content**:**
Term Work and Practical shall be based on the above syllabus.
Text Books**:**

1	Principles of Tissue Engineering by Robert Lanza, Robert Langer and Joseph Vacanti Pub.: Academic Press
2	Scaffolding in Tissue Engineering by Peter X. Ma, Jennifer Elisseeff, Pub.: by CRC Press
Reference Books **:**	
1	Tissue Engineering by Bernhard O. Palsson and Sangeeta N. Bhatia, Pub.: Prentice Hall
2	The Biomedical Engineering Handbook-Volume II (2nd Edition) – by Joseph D. Bronzino, CRC/IEEE Press, 2000.
3	Buddy Ratner et al. (eds), Biomaterials Science 2nd Edition, Elsevier
ICT References **:**	
1	https://nptel.ac.in/courses/102/106/102106081/
2	https://oyc.yale.edu/biomedical-engineering/beng-100/lecture-22

Mapping of CO with PO and PSO:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	1	1	0	0	1	0	2	3	2	1
CO2	3	3	2	2	2	1	1	0	0	1	0	2	3	3	1
CO3	3	3	3	3	3	1	2	1	1	1	1	3	3	3	2
CO4	3	3	3	3	3	1	1	0	0	1	1	3	3	3	2
CO5	3	3	3	3	3	2	3	1	2	2	2	3	3	3	3
CO6	3	2	3	2	2	3	3	2	2	2	2	3	3	3	3