# GANPAT UNIVERSITY

## FACULTY OF ENGINEERING & TECHNOLOGY

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|---|---|---|---|
| Programme | Bachelor of Technology | Branch/Spec. | Biotechnology |
| Semester | VII | Version | 1.0.0.0 |
| Effective from Academic Year | 2025-2026 | Effective for the batch Admitted in | July 2022 |
| Subject code | 2BT71PE02 | Subject Name | Tissue Engineering |

| Teaching scheme | | | | | | Examination scheme (Marks) | | | |
|---|---|---|---|---|---|---|---|---|---|
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | | CE | SEE | Total |
| | L | TU | P | TW | | | | | |
| Credit | 3 | - | 1 | - | 4 | Theory | 40 | 60 | 100 |
| Hours | 3 | - | 2 | - | 5 | Practical | 30 | 20 | 50 |

**Pre-requisites**

Good Knowledge of Human Tissues and basic chemistry.

**Course Outcomes**

On successful completion of the course, the students will be able to:

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| CO1 | **Demonstrate** a comprehensive understanding of the fundamentals, motivation, and core components of tissue engineeringg. |
| CO2 | **Analyze** the dynamic cellular processes in tissue engineeringg. |
| 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:<br>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:<br>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:<br>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:<br>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:<br>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**

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| 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**

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|---|---|
| 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. Pub.: CRC/IEEE Press. |
| 3 | Biomaterials Science by Buddy Ratner et al., Pub.: Elsevier. |

**ICT References**

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| 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 |