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	2BM71PE03		Subject Name			Elective-III: Transportation Phenomena in Living Systems			
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
Basic knowledge of anatomy and physiology, Concepts of heat and mass transfer mechanism.

Course Outcomes	
On successful completion of the course, the students will be able to:	
CO1	**Understand** the fundamentals of heat and mass transport in biological systems.
CO2	**Analyze** the thermal and mass transport models for biological tissues.
CO3	**Develop** skills to **analyze** the gas exchange mechanisms in respiratory and circulatory systems.
CO4	**Analyze** the mechanisms of gas exchange, oxygenation, and temperature regulation in artificial organs
CO5	**Evaluate** the efficiency and safety of artificial organs and devices in maintaining physiological functions.

Theory syllabus

Unit	Content	Hrs.
1	HUMAN THERMAL SYSTEM AND BIOHEAT TRANSFER: The human thermal system, Thermo-regulatory system, Production and heat loss, Modes of heat transfer, Heat transfer within a body, Heat transportation in tissues, muscles, skin and other Organs in different environmental temperatures, Structure of blood perfused tissue, Pennes bioheat model, Wulff continuum model, Chen-holmes continuum Model, Weinbaum, jiji and lemons bio heat model.	13
2	MASS TRANSPORT IN BIOMEDICAL SYSTEMS: Fundamentals and applications of mass transport, Biomedical mass transport, membrane, pores and diffusion, mass transport in systemic capillaries, mass transport in kidney and dialysis	10
3	GAS EXCHANGE AND MASS TRANSPORT IN THE RESPIRATORY SYSTEM: Mass balance on the lungs, Gas transport mechanism in lungs, Oxygen and carbon dioxide transport in the blood, O_2 and CO_2 transfer from tissues, Mass transfer resistances in respiratory systems.	10
4	ARTIFICIAL ORGANS: Artificial heart - lung devices: ideal heart – lung device, Oxygenator, temperature maintenance, gas flow requirement for artificial lungs, area requirement for membrane oxygenators. Mass transfer in skeletal, nervous, gastrointestinal system, cardio pulmonary system.	12

Practical content**:**
-Not applicable-

Text Books**:**	
1	Biomedical Engineering Principles: An Introduction to Fluid, Heat & Mass Transport Process by: David. O. Cooney

Reference Books **:**	
1	Basic Transport Phenomena in Biomedical Engineering by: Fournier, Ronald L.

2	Introduction to Biomedical Engineering by John Enderle & Joseph Bronzino
ICT References **:**	
1	https://archive.nptel.ac.in/courses/102/106/102106083/
2	https://www.youtube.com/watch?v=xtzLYHlUfbY
3	https://www.youtube.com/watch?v=4MdqkRO6WZs
4	https://www.youtube.com/watch?v=tW42IKR5jTw

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	1	2	3	2	0	0	0	1	1	2	3	2	1
CO2	3	3	2	3	3	2	0	0	0	1	1	2	3	3	2
CO3	2	3	2	3	2	1	0	0	1	2	1	2	2	3	2
CO4	2	3	3	3	2	2	0	1	1	2	2	2	2	3	3
CO5	3	3	2	3	3	3	1	3	1	2	3	3	3	3	2