GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Bachelor of Technology		Branch/Spec.	Biomedical Engineering	
Semester	V		Version	2.0.0.1	
Effective from Academic Year	2024-25		Effective for the batch Admitted in		July 2022
Course Code	2BM51PE01	Course Name	Cardiovascular System and Dynamics		

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 Cardiovascular System and Blood circulation in body.

Course Outcomes

COs	Description
CO1	**Develop** the applications based on knowledge of Fluid properties, their behavioural characteristics and would be able to calculate pressure drop across the column
CO2	**Apply** their knowledge to measure the various fluid properties and handle fluid based equipment and reactors
CO3	**Evaluate** the understanding of the underlying assumptions and models that are applied when solving fluid mechanics problems.
CO4	**Analyse** between the various approaches and solutions applied to a wide variety of fluid mechanics problems related to physiological processes, medical devices, and laboratory setups as used for testing and measuring
CO5	**Understand** the rheology of blood and mechanics of blood vessels.

Theory syllabus

Unit	Content	Hrs.
1	INTRODUCTION TO CARDIOVASCULAR SYSTEM Cardiovascular system, Geometry and materials of the heart, Electrical system of the heart, Mechanical events in cardiac cycle, correlation between mechanical and electrical events in the heart coronary circulation, Microcirculation, O_2 and CO_2 transport.	8
2	CARDIAC MUSCLE MECHANICS Ventricular pressure-volume relationship, Change in Pressure-Volume loop in heart valve defects, Operation of heart valves.	6
3	BIO FLUID MECHANICS Newton's laws, Stress, Strain, Elasticity, Hook's law, Fluid characteristics and viscosity, Newtonian fluids, Non-Newtonian fluids, , Laminar Flow of Non Newtonian Fluids, Flow of Non Newtonian Fluids in Elastic Fluids, methods for measuring viscosity, types of fluid flow, Conservation Laws, forces that drive or resist blood flow, Introduction to pipe flow, Laminar blood flow, Turbulent blood flow, Importance of turbulence, Vascular resistance to blood flow, Reynolds number, Poiseuille's law, Application of Poiseuille's law, Bernoulli equation, Pulsatile Flow. Applied BIOFLUID MECHANICS Conservation Laws	11
4	BLOOD RHEOLOGY AND BLOOD VESSEL MECHANICS Viscometry, Elements of Blood, Blood characteristics – Viscosity of blood, Einstein's equation, Biomechanics of red cell membrane, Apparent and relative viscosity, Blood viscosity variation,Casson‟s equation, Rheology of Blood In Micro vessels – Fahraeus-Lindquist effect and its inversion, Anatomy and physiology of blood vessels, Arterial wall as membrane – Uniaxial loading, Biaxial loading, Torsion, Hemodynamics of Large arteries – Ventricular outflow and the aorta, Pressure-flow relations and Vascular Impedance, Wave propagation and reflection.	10
5	COMPUTATIONAL FLUID DYNAMICS Computational fluid dynamics – CFD Code, Problem solving with CFD, Conservation Laws of Fluid Motion and Boundary Conditions, Turbulence and its modelling, The Finite Volume Method for Diffusion Problems and Convection-Diffusion Problems, Solution Algorithms for Pressure-Velocity Coupling in steady flows, Solution of Discretized Equations, The Finite Volume Method for	10

	Unsteady flows, Implementation of Boundary Conditions Application – Multiphasic computational models for cardiac flow and virtual cardiography.	
Practical content		
NA		
Text Books		
1	Biomechanics: Circulation by Y. C. Fung Pub.: Springer Verlag	
2	Biofluid Mechanics by Jagan. N. Mazumdar Pub.: World Scientific	
Reference Books		
1	Medical Physics & Biomedical Engineering by B. H. Brown & R. H. Smallwood Pub.: Overseas Press	
2	Biofluid Mechanics in Cardiovascular System by Lee Waite Pub.: McGraw Hill	
3	Snapshots of Hemodynamic by Nico Westerhof Pub.: Springer	
4	Applied Biofluid Mechanics by Lee Waite and Jerry Fine Pub.: McGraw-Hill Education	
ICT/MOOCs Reference		
1	https://nptel.ac.in/courses/112104118/	
2	https://nptel.ac.in/courses/112105171/	
3	https://nptel.ac.in/courses/105103095/	

Mapping of CO with PO and PSO:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	2	0	1	1	1	2	1	1	2	2
CO2	2	3	3	2	2	1	0	1	0	0	2	2	2	3	2
CO3	3	2	3	1	3	2	0	1	2	1	2	2	1	2	2
CO4	2	2	3	2	3	2	0	1	3	2	4	3	2	3	2
CO5	3	3	2	1	2	3	0	0	1	2	3	2	2	3	2