BMPC2004 BIOMECHANICS (3-0-0)

Course Objectives:
The course in Biomechanics aims to provide students with a comprehensive understanding of fluid mechanics principles as applied to biological systems. It seeks to develop advanced knowledge of circulatory and biological fluid dynamics, exploring complex physiological processes through scientific and mathematical modeling. Students will learn to analyze fluid properties, flow characteristics, and transport mechanisms within living systems. The objective is to bridge theoretical fluid mechanics with practical biomedical applications, enabling students to comprehend the intricate fluid dynamics of human physiology and develop skills in analyzing biological fluid systems.

Module-1(08 Hrs.)
Properties of fluids: viscosity, density, specific volume, specific weight. Pressure and its measurement.

Module-II (08 Hrs.)
Kinematics of fluid flow: types of fluid flow, continuity equation. Dynamics of fluid flow: Euler’s equation, Bernoulli’s equation.

Module-III (08 Hrs.)
Circulatory biofluid mechanics: systemic and pulmonary circulations, circulation in the heart. Blood Rheology.

Module-IV: (11 Hrs.)
Models of biofluid flows: Poiseuille’s flow, pulsatile flow. Non-Newtonian fluids: power-law model, Herschel-Bulkley model, Casson model. Krogh model of oxygen diffusion from blood vessel to tissue. Dimensional analysis and modelling. Macrocirculation: the heart, blood flow in arteries and veins Microcirculation: microvascular beds, mass transport and heat transfer in microcirculation, lymphatic system.

Module-V: (10 Hrs.)
Other biological flows within the body: flow in lungs, intraocular fluid flow, lubrication of joints, flow through the kidney Modelling and experimental techniques: in silicobiofluid mechanics, in vitro and in vivo biofluid mechanics.

Course Outcomes:
CO1: Analyze and explain fundamental fluid properties and measurement techniques, demonstrating proficiency in understanding viscosity, density, pressure, and their significance in biological systems.
CO2: Apply fluid flow theories and mathematical models, including Bernoulli's and Euler's equations, to interpret complex physiological fluid dynamics and circulation mechanisms.
CO3: Evaluate blood rheology and advanced models of biofluid flows, including non-Newtonian fluid behaviors and oxygen diffusion models in biological tissues

.CO4: Critically examine macro and microcirculation processes, including blood flow in cardiovascular systems, mass transport mechanisms, and heat transfer within microvascular networks..

CO5: Design and interpret experimental and computational techniques for studying biofluid mechanics, integrating in silico, in vitro, and in vivo research methodologies across various biological systems.

Books:

- J. N. Mazumdar, Biofluid Mechanics, World Scientific, 2004
- David A Rubenstein, Wei Yin and Mary D Frame, Biofluid Mechanics, Academic Press (Elsevier), 2013