

BMPE3003 MECHANOBIOLOGY AND TRANSDUCTION (3-0-0)

Course Objectives:

This course introduces the principles of mechanics applied to biological systems, focusing on the musculoskeletal system and human movement. It covers statics, dynamics, stress-strain behavior, biomechanical properties of tissues, and gait analysis, including AI applications, enabling students to understand and analyze biomechanical functions relevant to medicine and sports.

Module-I: (10 Hrs)

Introduction – forces, moment and torque, free-body diagram (FBD), analysis of systems in equilibrium, mechanics of elbow, shoulder, spinal column, hip, knee, ankle.

Module-II: (10 Hrs)

Introduction to dynamics, linear kinematics and kinetics, angular kinematics and kinetics, work-energy methods, conservation of energy principle, application to athletics, impulse and momentum.

Module-III: (08 Hrs)

Introduction to deformable body mechanics, stress and strain, generalized Hooke's law, principal stress and principal strain, constitutive equations, stress-strain diagram

Module-IV: (08 Hrs)

Mechanical behaviour of biological tissues - bone, tendons, ligaments, muscles and cartilages, various testing methods, viscoelastic models

Module-V: (08 Hrs)

Gait analysis, measurement of gait parameters, techniques for recording and measuring movements and forces - force platforms and motion analysis system, AI based gait analysis, and AI applications in sports and medicine

Course Outcomes (COs)

- CO1: Recall fundamental biomechanical concepts like forces, moments, torque, and stress-strain relationships applied to human anatomy.
- CO2: Explain the dynamics of body movement, including kinematics, kinetics, and principles of work, energy, impulse, and momentum.
- CO3: Apply equilibrium and deformable body mechanics to analyze joint systems such as the elbow, spine, hip, and knee.
- CO4: Examine and compare the mechanical behavior of biological tissues through stress-strain analysis and viscoelastic testing models.
- CO5: Assess gait parameters and evaluate biomechanical performance using motion analysis techniques and AI-based systems in clinical and sports contexts.

Reference Books:

1. Nihat Ozkaya, Fundamentals of biomechanics: Equilibrium, Motion and deformation, Springer.
2. Y.C Fung, Biomechanics – Mechanical Properties of Living Tissues, Springer
3. Roger Bartlett, Introduction to Sports Biomechanics: Analysing Human Movement Patterns, Taylor and Francis
4. Nachiappan Chockalingam, Technologies and Techniques in Gait Analysis, Institution of Engineering and Technology