

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Biomedical Engineering (31)

SUBJECT NAME: Applied Biomechanics

SUBJECT CODE: 3713115

ME 1st Semester

Type of course: Elective Subject

Prerequisite: Human Anatomy & Physiology, Mechanics of Solids, Fluid Mechanics

Rationale: This course is offered to Post Graduate Students for understanding the principles of solid and fluid mechanics, forces and relevant motions in day-to-day motion or activities. The course aims to make students familiar with the application of biomechanics in motion and exercises and research.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	Weightage %
1	Basics of Solid Mechanics: Geometry, Vector Algebra, Scalar and vector, Force Vectors, Moment and Torque, Center of Gravity, Equilibrium, Work Energy and Power, Stress, Strain, Elastic Modulus, Poisson's Ratio, Bulk Modulus, Hooke's law	8	15
2	Basics of Fluid Mechanics: Fluid, Intrinsic Fluid Properties – Density, Viscosity, Compressibility and Surface Tension, Hagen-Poiseuille equation, Fluid mechanics in straight tube – Laminar flow, Turbulent flow, Flow Development, Shear Stress, Flow Pulsatility	8	15
3	Joint Biomechanics: Types of Joint, Dynamics (Dynamics, Kinematics and Kinetics, Linear, Angular and general motions, distance and displacement, speed and velocity, acceleration, inertia and momentum, degree of freedom, reference planes and coordinate systems), Joint Mechanics (muscle forces, moment and equilibrium) - Elbow, Hip, Knee, Shoulder, Ankle	8	20
4	Application of Biomechanics in Physical Education, Coaching, Strength and Conditioning, Kinematic Study of motion for a body movement and motion analysis (GAIT analysis, jumping, running, lifting)	5	15
5	Cardiovascular Biomechanics: Structure - Native and Mechanical Heart valves and vessels, fluid – solid interaction, Blood Rheology, Blood Vessel Mechanics	8	20
6	Disease conditions of anatomical structures (stenosis, atherosclerosis, vessel hardening), muscle tearing and damage and its effects on human	5	15

Reference Books:

1. N. Ozkaya and M. Nordin, Fundamentals of Biomechanics-Equilibrium, Motion and Deformation, springer-verlag, 2nd edition 1999
2. I. H. Shames and K. M. Rao. Engineering mechanics: statics and dynamics, 4th Edn, Pearson. 2006
3. Krishnan B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, Biofluid Mechanics – The Human Circulation, CRC Press, 2007
4. Y C Fung, Biomechanics: Mechanical Properties of Living Tissues, springer, 2nd edition, 1993
5. Duane knudson, Fundamental of biomechanics, springer, 2nd edition 2007

Course Outcome:

After learning the course the students should be able to:

- Understand human body movement and posture
- Analyse the relationship between forces and motion
- Model the cardiovascular interactions of blood flow.
- Design the rehabilitation devices for the limb disorders

List of Experiments:

1. To perform Motion Analysis of walking
2. Perform Vector Analysis of GAIT Cycle
3. To understand forces during vertical jump
4. To study Body Motion during a sport activity – muscles involved, range of motion, Degree of freedom
5. To understand Implications of over exertion during sports activity
6. To perform Blood flow simulation in ANSYS Fluent

Major Equipment:

- GAIT analysis system including camera, reflective markers and system with software, force plate
- computer system with simulation software for computational fluid dynamics (blood flow)

List of Open Source Software/learning website:

- <https://journals.humankinetics.com/journal/jab>
- <https://www.ansys.com/academic> - ANSYS free student software