



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Bio Medical Engineering

Course / Subject Code : ME01031041

Course /Subject Name : Applied Biomechanics

w. e. f. Academic Year:	2024-25
Semester:	1 st Semester
Category of the Course:	PEC

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.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Understand human body movement and posture
02	Analyse the relationship between forces and motion
03	Model the cardiovascular interactions of blood flow.
04	Design the rehabilitation devices for the limb disorders

*Revised Bloom's Taxonomy (RBT)

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR		C	Theory		Tutorial / Practical	
			ESE (E)		PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of 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.	9	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).	6	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 motion (e.g. sports injuries of muscles).	6	15
Total		45	100

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



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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

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