GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Bachelor of Technology					Branch/Spec.		Biomedical Engineering	
Semester	VI					Version		1.0.0.0	
Effective from Academic Year			2024-25			Effective for the Batch admitted in			July 2022
Course Code	2BM6110		Course Name			Biomechanics Design & Ergonomics			
Teaching Scheme						Examination Scheme (Marks)			
(Per week)	Lecture (DT)		Practical (Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	-	1	-	4	Theory	40	60	100
Hours	3	-	2	-	5	Practical	30	20	50

Pre-requisites

Good Knowledge of Mechanics, Muscular system, Skeleton system & body joints.

Course Outcomes

On successful completion of the course, the students will be able to:

CO1	**Understand** and **Analyse** various joint forces and muscle forces at static condition.
CO2	**Analyse** the biomechanics of fundamental joint movements.
CO3	**Understand** the basics of design ergonomics.
CO4	**Evaluate** the fundamentals of bio-solid mechanics.
CO5	**Apply** the knowledge of joint mechanics.
CO6	**Develop** computational mathematical modelling applied in biomechanics.

Theory Syllabus

Unit	Content	Hrs.
1	INTRODUCTION TO MECHANICS AND LOADS ON HUMAN BODY Introduction to forces and force vectors, Coplanar, collinear and concurrent forces, moment and torque, Statics: Analysis of systems in equilibrium, Applications of statistics to Biomechanics, Mechanics of elbow, shoulder, spinal column, hip, knee, ankle. Reference position and cardinal planes, Forms of motion and movements with respect to cardinal planes, Internal forces and external forces acting on human body, Effect of forces, Static and Dynamic Equilibrium. Basics of Anthropometry: Static and Dynamic.	4
2	BIOMECHANICS OF JOINTS & MUSCLES: ITS FUNDAMENTAL Introduction to Biomechanics, Fundamental research domains and application areas of biomechanics, Types of joints, Properties of skeletal muscles, Tension in muscular fibres, velocity & length – tension relationship, Mechanical characteristics of muscles: Power, endurance, fatigue Torque.	6
3	BIOMECHANICS OF UPPER & LOWER EXTREMITIES Shoulder: Structure and movements of Shoulder joint, Loading conditions on Shoulder joint Elbow: Structure and movements of Elbow joint, Loading conditions on Elbow joint Hip: Structure and movements of Hip joint, Loading conditions on Hip Joint Knee: Structure and movements of Knee joint, Loading conditions on Knee Joint Co-relation between Biomechanics of (i) Shoulder & Hip (ii) Knee & Elbow.	8
4	HUMAN MOVEMENT & EQUILIBRIUM Classification of mechanical levers and its fundamentals, Classification of anatomical levers and its examples, Equations describing static and dynamic equilibrium of human body, Centre of Gravity & its measurement techniques, Center of Mass and its importance in biomechanics.	7
5	KINETICS & KINEMATICS OF HUMAN POSTURES Basics of Kinematics & kinetics of human postures, Biomechanical analysis two legged and one legged static stance, biomechanical analysis of sitting and lying, linear kinematics and kinetics, angular kinematics and kinetics, work-energy methods, conservation of energy principle, Application to athletics, impulse and momentum. Computational biomechanics, continuum mechanics.	7

6	KINETICS & KINEMATICS OF HUMAN LOCOMOTION Gait cycle & its phases, Ground reactance forces during gait cycle, Gate measurement & analysis its methods, techniques for recording and measuring movements and forces - force platforms and motion analysis system, Applications of these equipment in biomechanics, performance improvement and injury prevention.	6
7	MODELING AND OCCUPATIONAL ERGONOMICS Introduction to ergonomics, General ergonomics, Biomechanical factors affecting ergonomics, understanding biomechanics of occupation involving heavy stress on upper or lower limb, Improvements in design of tools over period of time: A case study approach for assisting device. Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics – Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand-arm vibration, Application of 3D printing technology.	7

Practical content	
Term Work and Practical shall be based on the above syllabus.	
Text Books	
1	Basic Biomechanics by Susan J. Hall Pub.: McGraw-Hill
2	GAIT Analysis- Normal and Pathological Function by Jacquelin Perry Pub.: Slack Inc.
3	Handbook of Biomedical Engineering by Bronzino Joseph D. Pub.: CRC Press
Reference Books	
1	Prosthetics and Orthotics By: Donald G. Shurr et al.2e Pub.: Prentice Hal
2	Rehabilitation Engineering By Robinson C.J, Pub.: CRC Press
3	Fundamentals of Biomechanics: Equilibrium, Motion and Deformation by Nihat Ozkaya Pub.: Springer
4	Biomechanics – Mechanical Properties of Living Tissues by Y.C Fung Pub.: Springer
ICT/MOOCs Reference	
1	https://nptel.ac.in/courses/112/106/112106248/
2	https://www.youtube.com/watch?v=QcNrMBl3pWQ

Mapping of CO with PO and PSO:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	1	2	3	1	1	1	0	0	2	0	2	1	1
CO2	3	3	2	2	3	1	1	2	0	0	2	0	2	1	1
CO3	3	3	2	1	3	1	1	2	1	0	1	0	1	2	3
CO4	3	3	2	1	3	1	1	1	0	0	1	1	2	1	3
CO5	3	3	2	1	3	1	1	1	1	0	1	1	2	2	3
CO6	3	3	2	1	3	1	1	1	1	0	1	1	2	2	3