UPES

End Semester Examination, December 2023

Course: Biomechanics
Semester   : 3rd
Program: B.Tech Biomedical Engineering
Duration   : 3 Hours
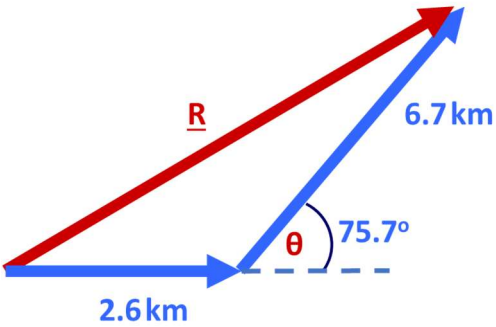Course Code: HSBE2001   Max. Marks: 100

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	Which mechanical property characterizes the ability of a material to return to its original shape after deformation?	1.5	CO4
Q2	In stress-strain analysis, what is the slope of the linear region on the stress-strain curve known as?	1.5	CO4
Q3	What is the primary function of tendons in the human body?	1.5	CO2
Q4	Which biomechanical property is particularly important for materials subjected to repetitive loading over time?	1.5	CO3
Q5	What type of stress is applied uniformly in all directions across a tissue?	1.5	CO3
Q6	Which parameter is used to describe the ability of a material to absorb energy before rupturing?	1.5	CO4
Q7	In the context of biomechanics, what is the primary function of ligaments?	1.5	CO4
Q8	What is the term for the process of bone healing where a callus forms around the fracture site?	1.5	CO3
Q9	When analyzing joint forces, what does the term "torque" refer to?	1.5	CO3

Q10	Why does resistance training contribute to bone health and density?	1.5	CO3
Q11	What do you mean by biomechanics?	1.5	CO1
Q12	Mention the types of muscles in the human body.	1.5	CO2
Q13	Define statics and dynamics.	1.5	CO2
Q14	Inertia depends on which of the following factors? a. position b. force c. mass d. velocity	1.5	CO2
Q15	Draw the free body diagram of a book kept stationary on a table. Assume the table to be at rest.	1.5	CO2
Q16	Why is coefficient of static friction greater than dynamic friction?	1.5	CO2
Q17	What is the degree of freedom of a human arm? Justify your answer.	1.5	CO2
Q18	Differentiate between scalar and vector quantities.	1.5	CO2
Q19	Give an instance where Newton's third law is applicable to human biomechanics.	1.5	CO2
Q20	Who among the following is considered as the father of modern biomechanics? a. Rene Descartes b. Leonardo DaVinci c. Galileo Galilei d. Giovanni Borelli	1.5	CO1

Section B
(4Qx5M=20 Marks)

Q 1	Describe the viscoelastic behavior of soft tissues. How does this property influence the response of tissues to dynamic loads?	5	CO4
Q2	Elaborate on the mechanical properties of tendons and ligaments. How do these properties contribute to their specific functions in the musculoskeletal system?	5	CO3
Q3	What is the resultant vector of a horizontal displacement of 2.6 km and a vertical displacement of 6.7 km as shown in Fig. 1?	5	CO2

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	What is the angle made by the resultant with the horizontal displacement? Fig. 1		
Q5	Consider a person standing on the ground, which offers friction, being pushed with a constant velocity. Show that the 1st law of equilibrium is valid in this case.	**5**	**CO2**
	**Section C** **(2Qx15M=30 Marks)**		
Q 1	Discuss the role of time-dependent behavior in biomechanics. How does the time-dependent response of biological tissues impact their overall mechanical performance?	**15**	**CO3**
Q2	Consider the elbow joint mechanism as shown in Fig. 2. Draw the free body diagram of the elbow joint and calculate by how much factor the bicep muscles overpower the combined weight of forearm and the book in order to be able to hold the book.	**15**	**CO2**
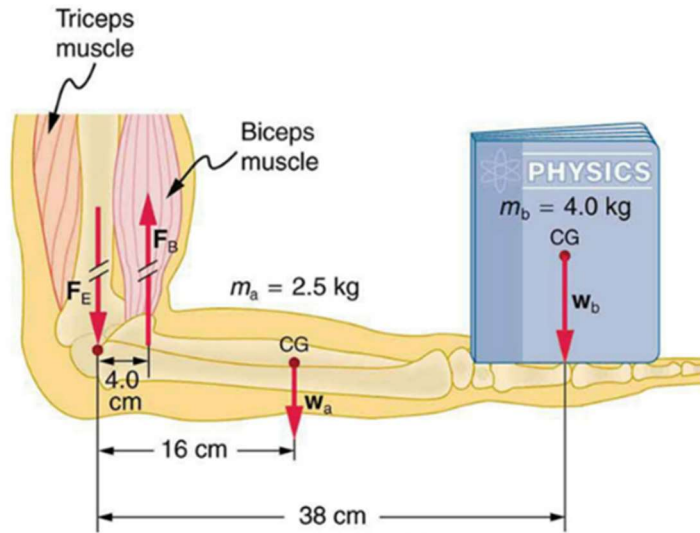
Fig. 2

	Section D		
	(2Qx10M=20 Marks)		
Q 1	Discuss the significance of biomechanics in designing rehabilitation exercises for soft tissue injuries. How can an understanding of mechanical properties guide the development of effective rehabilitation programs?	**10**	**CO4**
Q2	Write a note on degrees of freedom of a kinematic link.	**10**	**CO2**