Name:

Enrolment No:

UPES

End Semester Examination, May 2025

Course : Biomechanics **Semester : II**

Program : B.Tech - Biomedical Engineering **Duration : 3 Hours**

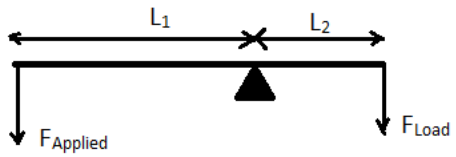
Course Code: HSBE1004 **Max. Marks: 100**

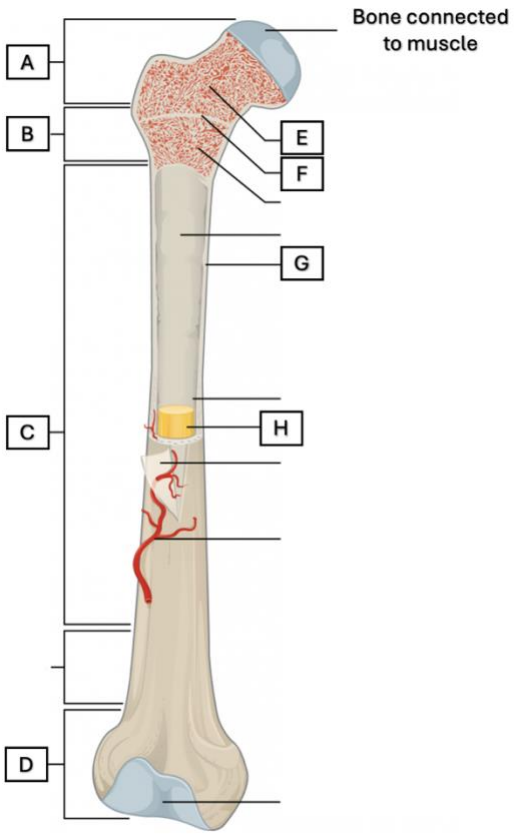
Instructions: All questions are compulsory.

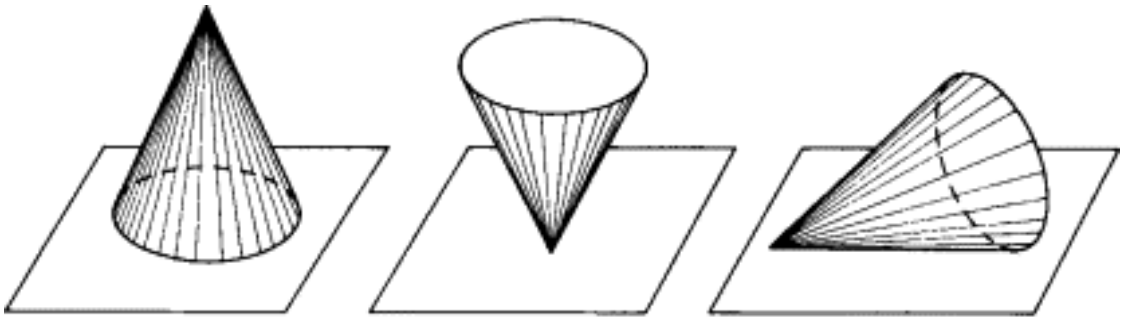
Please read the questions carefully. The paper contains four sections.

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	Which of the following is true when a body is stationary? a. The force acting on it is not in contact with it b. The body is in vacuum c. There is no force acting on it d. The combination of forces acting on it balance each other	1.5	CO1
Q 2	Which of the following bones is part of the axial skeleton? a. Humerus b. Femur c. Sternum d. Tibia	1.5	CO1
Q 3	In which direction should the force be applied to balance a force in the direction of North-East direction? a. South b. West c. South-West d. North-East	1.5	CO1
Q 4	The first condition of equilibrium of a body is ___ a. Sum of all force on a body should be zero b. Sum of all moments on a body should be zero c. Sum of the initial and final force should be zero d. Relative difference of forces should be zero	1.5	CO1
Q 5	Among the following which cannot be a resultant force of 5 N and 10 N? a. 4 N b. 5 N c. 8 N d. 12 N	1.5	CO1
Q 6	Which of the following is an example of an isometric exercise? a. Bicep curls	1.5	CO1

	b. Squats c. Planks d. Running		
Q 7	Two forces act on a ball. One of the forces is positive and acts towards right, the other one acts towards left and is _____ a. Negative b. Positive c. Neutral d. Having a magnitude of 5 N	1.5	CO1
Q 8	A motor unit is a. A single motor neuron and all the muscle fibers it innervates b. A single muscle fiber and all the motor neurons that innervate it c. All the motor neurons supplying a single muscle d. A combination of bone-muscle-neuron	1.5	CO1
Q 9	True or false: "Biomechanics is the study of the interaction between the muscles and nerves."	1.5	CO1
Q 10	The length of this is reduced while the muscle contracts a. Sarcomere b. I-Band c. A-Band d. H-Zone	1.5	CO1
Q 11	Three forces act on a body. Two of them are $7\hat{i} - 13\hat{j}$N and $2\hat{i} - 11\hat{j}$. What is the value of the other force? a. $-9\hat{i} + 24\hat{j}$ b. $-24\hat{i} + 9\hat{j}$ c. $24\hat{i} + 9\hat{j}$ d. $-9\hat{i} - 24\hat{j}$	1.5	CO1
Q 12	Weightlifting can result in a dramatic increase in skeletal muscle mass. This increase in muscle mass is primarily attributable to which of the following? a. Hypertrophy of individual muscle fibers b. Increase in skeletal muscle blood supply c. Increase in the number of motor neurons d. Increase in the number of neuromuscular junctions	1.5	CO1
Q 13	Which of the following is an example of a closed kinetic chain exercise? a. Bench press b. Leg press c. Squat d. Lat pulldown	1.5	CO1
Q 14	Which of the following is an example of a force-velocity curve? a. An athlete's heart rate during a workout b. A graph showing an athlete's performance during a game c. A graph showing the relationship between an athlete's strength and speed	1.5	CO1

	d. A graph showing an athlete's reaction time to a stimulus		
Q 15	This bone protects the brain a. Cerebellum b. Calcium c. Cerebrum d. Cranium	1.5	CO2
Q 16	The unit of linear velocity is a. m/s b. m/L c. m/s^2 d. rad/s^2	1.5	CO2
Q 17	The difference between cartilage and bone is a. Bone is firm, and cartilage is rubbery b. Bone is inside the body, and cartilage is outside c. Bone is rubbery, and cartilage is firm d. Bone is a more primitive tissue than cartilage	1.5	CO2
Q 18	The joint in our elbow is an example of a. Hinge joint b. Ball and socket joint c. Pivot joint d. Gliding joint	1.5	CO2
Q 19	Interval training is used for the development of a. Flexibility b. Agility c. Explosive strength d. Endurance	1.5	CO2
Q 20	Metacarpals and phalanges are examples of a. Saddle joint b. Hinge joint c. Condyloid joint d. Ball and socket joint	1.5	CO2
Section B (4Qx5M=20 Marks)			
Q 21	Define the following **(1.25 marks each)** a. Force-motion principle b. Segmental Interaction c. Range of Motion d. Optimal Projection	5	CO1
Q 22	a. Describe biomechanics. **(2 marks)** b. Discuss three major applications of biomechanics. **(3 marks)**	5	CO2
Q 23	a. Explain mechanical advantage **(2.5 marks)** b. Write the expression for mechanical advantage in the following diagram **(2.5 marks)** 	5	CO2

Q 24	Explain the following with an example a. Isometric muscle movement b. Concentric muscle movement c. Eccentric muscle movement	5	CO2
	Section C **(2Qx15M=30 Marks)**		
Q 25	a. Draw a free body diagram for a person performing squats as shown in the following figure **(5 marks)** b. Illustrate with the help of a diagram how the squat posture shown above will change if a person has anatomy as mentioned below: i. Long torso and short femur **(2.5 marks)** ii. Short torso and long femur **(2.5 marks)** c. Analyze which of the following will offer higher stability to the posture: a narrow distance between feet or a wider distance between feet. **(2.5 marks)** d. How would you calculate the optimal distance between the feet for a perfectly balanced squat? **(2.5 marks)** 	15	CO3
Q 26	a. Identify the parts of the bone structure as shown in the following diagram. Label and briefly explain each part (A, B, C, D, E, F, G, H). **(1 mark each)** b. Bone tissue is made up of matrix and salts. Justify their importance by explaining how these two components contribute to the properties of the bone. **(2+2 marks)** c. Predict what would happen if the salts in the bone were dissolved entirely using an acid. Explain your answer. **(3 marks)** 	15	CO4

Section D (2Qx10M=20 Marks)			
Q 27	Identify and draw two types of movements possible at the following body parts **(2.5 marks each)** a. Shoulder and knees b. Forearm c. Chin d. Knuckles	10	CO3
Q28	a. Define equilibrium in statics. **(1 marks)** b. Explain the following types of equilibrium and justify by drawing the free body diagram of the cones shown in the following diagram **(3 marks each)** i. Stable equilibrium ii. Unstable equilibrium iii. Neutral equilibrium 	10	CO4