

Marks distribution for each question is indicated within brackets.
Assume any suitable data that may be required for solution, stating clear justifications

Answer all questions.

- (1) (a) What are the major functions of bone and muscle? Classify the different types of muscles.
(b) What are the differences between cartilaginous and synovial joints? Name few anatomical joints of each type.
(c) What are the biomechanical functions of the 'Patella' in the knee joint?
(d) What are the factors that influence 'joint stability'?

(4 + 5 + 3 + 3 = 15)

- (2) (a) What is meant by 'Gait Cycle'? Clearly indicate the different phases of gait cycle.
(b) Briefly describe the principle of 'Inverse Dynamics' method along with the mathematical formulation.
(c) State clearly the steps and governing equations required for finding out joint forces and moments in a limb segment using 'Inverse Dynamics Method'?

(4 + 4 + 7 = 15)

- (3) (a) What are the joints and bones that constitute a shoulder girdle? Name the muscles that constitute the 'rotator cuff' and state its function.
(b) Name the major muscles, ligaments and tendons of the 'Hip Joint'.
(c) Find the number of degrees of freedom (DOF) of the shoulder and elbow. Indicate clearly the degrees of freedom of constituent joints and the constraints, citing justifications.

(6 + 4 + 5 = 15)

- (4) A subject carries a sack of weight 100 N with an elbow flexed at 90° and hands in a neutral position of rotation. The distances of the points of action of the forces on the forearm and on the humerus from axis A are shown in Figure 1.

Take limb weight = 15 N

Cross-sectional areas of the muscles are:

(i) $A_{Biceps} = 520 \text{ mm}^2$

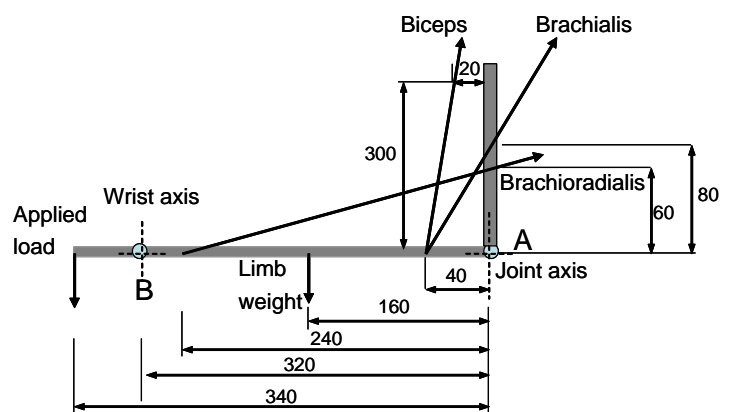
(ii) $A_{Brachialis} = 500 \text{ mm}^2$

(iii) $A_{Brachioradialis} = 120 \text{ mm}^2$

Assuming all the three muscles are stressed to the same intensity and friction coefficient $\mu = 0.02$, find:

- (a) Forces produced in each muscle.
(b) Humero-radial joint reaction force.
(c) Force imposed by the ligamentous system.

(6 + 3 + 6 = 15)



All dimensions are in mm

Figure 1