

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 tendon and ligament? Name the major muscles, ligaments and tendons in the knee joint.
- (c) What are the biomechanical functions of the 'Patella' in the knee joint?
- (d) What are the differences between cartilaginous and synovial joints? Name few anatomical joints of each type.
- (4 + 4 + 3 + 4 = 15)

- (2) (a) What is meant by 'Gait Cycle'? What are the different phases of gait cycle.
- (b) Briefly describe the principle of 'Inverse Dynamics' method along with mathematical formulation. Considering a limb segment, state how this method is useful in calculating musculoskeletal forces.
- (7 + 8 = 15)

- (3) (a) What are the joints and bones that constitute a 'Knee Joint'?
- (b) What are the movements offered by the 'Hip Joint'?
- (c) What are the joints and bones that constitute a shoulder girdle? Name the muscles that constitute the 'rotator cuff' and state its function.
- (d) Indicate the lines of action of major muscles and joint reaction force acting on the femur, using a free body diagram.
- (3 + 3 + 5 + 4 = 15)

- (4) A subject carries a sack of weight 120 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.

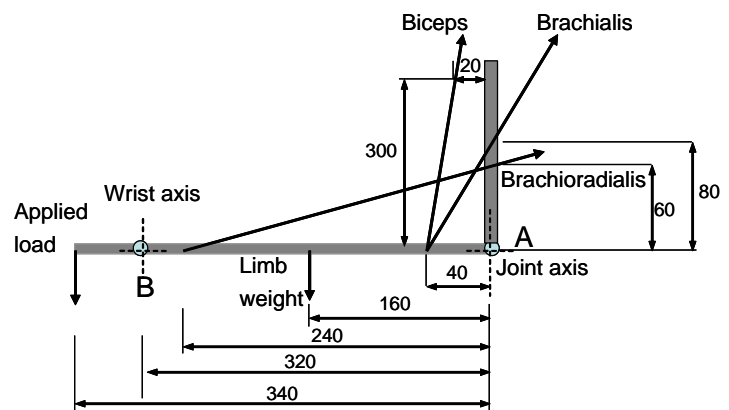
Take limb weight = 25 N

Cross-sectional areas of the muscles are:

- (i) $A_{Biceps} = 500 \text{ mm}^2$
 (ii) $A_{Brachialis} = 480 \text{ mm}^2$
 (iii) $A_{Brachioradialis} = 100 \text{ mm}^2$

Assuming all the three muscles are stressed to the same intensity, find:

- (a) Forces produced in each muscle.
 (b) Force imposed by the ligamentous system
 (c) Humero-radial joint reaction force, assuming that the combined component of the ligaments acts at 80 mm from the joint axis along the radial shaft.



All dimensions are in mm

Figure 1

(6 + 3 + 6 = 15)