Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
(A constituent unit of MAHE, Manipal 576104)

IV SEMESTER B.Tech. DEGREE END SEM EXAMINATIONS APR/MAY 2019
SUBJECT: BIOMECHANICS (BME 3282)
Open Elective I
(REVISED CREDIT SYSTEM)
Tuesday, 7th May 2019, 2 pm to 5 pm

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to Candidates:

1. **Answer all the questions.**
2. **Draw labeled diagrams wherever necessary.**

1. (a) Write down the design requirements for a bone. Provide an example to explain how certain bones in human body are designed primarily to accelerate the speed of movement with minimal energy expenditure. 05

(b) At what percentage of the resting length of skeletal muscle is the total muscle-tension developed? Explain the contribution of the components of musculotendinous unit responsible for the generation of total tension in the muscle. 05

2. (a) Write about at least five factors that are responsible for increasing the muscle contractile force. 05

(b) A person is holding a 100 N weight in his hand. The weight is at a distance of 0.3 meters from the center of rotation of elbow. 05

(i) If the forearm is parallel to the ground, what is the torque about the elbow due to the weight?

(ii) If that torque is counteracted by the biceps muscle acting with a moment arm of 2.5 cm, what is the force of that biceps muscle?

(iii) If the triceps muscle (an elbow extensor) is co-contracting and exerting a force of 1000N, how would that quantitatively affect the biceps force needed to keep the elbow stationary? Moment arm of triceps is 0.04 m. Draw a free body diagram for all the above three cases.

3. (a) A punter kicks a football with a resultant velocity of 18 m/s at an angle of 48°. The ball leaves the foot at a height of 0.8 m. If the ball experiences a constant vertical acceleration of -9.8 m/s^2 while it is in the air, what will the ball's position be after 1.5 seconds from the ground? 03

(b) Illustrate the sub-phases of the support-phase of a human gait cycle. 04

(c) A 108 cm, 0.73 kg golf club is swung for 0.5 seconds with a constant acceleration of 10 rad/s^2. What is the linear momentum of the club head when it impacts the ball? 03

4. (a) A forearm weighing 35 N is held at an angle of 45^o to the vertically oriented humerus bone. The center of gravity of the forearm is located at a distance of 15 cm from the center of the elbow joint. The elbow-flexor muscles are attached at an average distance of 3 cm from the center of the elbow joint. Calculate the force to be exerted by the elbow-flexors, to maintain the same position. Calculate the force to be exerted by the elbow-flexors, if a weight of 50 N is held in the hand, at a distance of 25 cm from the center of the elbow joint. Draw the free body diagram. 03

(b) Explain the pattern of the vertical ground reaction force generated during the support phase of the gait cycle while running (both in case of mid-foot striker and heel striker). 04

(c) At the instant of takeoff, a 60 kg diver's angular momentum about his transverse axis is 20 kg m^2/s. His radius of gyration about the transverse axis is 1.0 m at this instant. During the dive, the diver tucks and reduces his radius of gyration about the transverse axis to 0.5 m. 03

(i) At takeoff, what is the diver's angular velocity about the transverse axis?

(ii) After the diver tucks, what is his angular velocity about the transverse axis?

(iii) What do you infer from (i) & (ii)?

5. (a) Diagrammatically represent and explain how lift force can be generated in a discus-shaped object. Also explain how the object might undergo stalling before completing its trajectory. 05

(b) Explain in detail about 'paddling' and 'sculling' movements. 05