Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University, Manipal – 576 104

1st SEMESTER M.Tech. (BME) DEGREE END-SEM. EXAMINATIONS, NOV/DEC 2015

SUBJECT: BIO-MECHANICS & BIO-DYNAMICS (BME 507)
(REVISED CREDIT SYSTEM)
Thursday, November 26th, 2015 : 2.00 pm - 5.00 pm

TIME: 3 HOURS **MAX. MARKS: 100**

Instructions to Candidates
1. Answer any FIVE full questions **2. Draw neat figures wherever necessary**

1. (a) A basketball player weighing 105 kg, applied a vertical force of 2980 N against the ground for 0.11 seconds. Calculate the height that his center of mass reached during his rebound. [4]

   (b) Will a person be able to float horizontally above or below the surface of water without any supportive movements? Justify with reasons. If not, based on what condition will the person be able to float in water? [8]

   (c) Explain in detail, the process of muscle excitation-contraction coupling. [8]

2. (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. [4]

   (b) (i) Draw the complete human gait cycle, considering right lower extremity as the reference extremity. [4+4]

   (ii) What are the factors that affect the muscle strength?

   (c) With appropriate examples, write about the muscle action that creates, opposes, stabilizes and neutralizes movements. [8]

3. (a) A runner weighing 52 kg is running forward at 5 m/s when his foot strikes the ground. The vertical ground reaction force acting under his foot at this instant is 1800 N. The friction force acting under his foot is a 300 N braking force. These are the only external forces acting on the runner other than the gravitational force. What is the runner's vertical acceleration, as a result of these forces? [4]

(b) (i) The center of mass of the upper-arm segment is at 48.6% of the length of the segment from the shoulder joint along the vertical axis of the segment. Calculate the coordinates of the center of mass of the upper-arm segment with following details: coordinates of shoulder joint and elbow joint are (5.7, 3.2) and (7.9, 4.1) respectively. [6+2]

(ii) Write about the parallel axis theorem.

(c) What is the point at which the resultant (lift and drag) air-force acts on a projectile? Explain how does it affect the projectile's trajectory? [8]

4. (a) Provide an example to justify that the segmental movement can occur without the support of muscle action. [4]

(b) A badminton shuttlecock is struck by a racquet at an angle of 35^{o}, giving it an initial speed of 10 m/s. Calculate the maximum height it has reached. How far will it travel horizontally before being contacted by the opponent's racquet at the same height from which it was projected? [8]

(c) When an object is projected in the air, how is the profile-drag-force generated? What changes can be implemented in order to reduce the profile- drag-force? [8]

5. (a) The radius of gyration of the thigh-segment with respect to transverse axis at the hip joint is 54% of length of the thigh-segment. The mass of the thigh-segment is 10.5% of total body-mass and the length of the thigh segment is 23.2% of total body-height. What is the moment of inertia of the thigh-segment with respect to the hip joint, having total body mass and height as 60 kg and 1.6 m respectively? [4]

(b) Explain the influence of stride length and stride rate in the gait cycle of a runner. [8]

(c) (i) Differentiate Static stretching from Ballistic stretching. [4+4]

(ii) Explain the effect of muscle temperature on the function of muscle.

6. (a) (i) A racing shell has a volume of 0.38 m^3. When floating on the sea, how many people can it support, each weighing about 700 N? [2+2]

(ii) With an example, write about circumduction.

(b) Illustrate with two examples, to show how the muscle's "angle of pull" affect the magnitude of the torque generated at a joint. [8]

(c) Explain the biomechanical principles of "Coordination Continuum", "Balance", "Segmental Interaction" and "Optimal Projection" associated with human movement. [8]