Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University, Manipal – 576 104

3rd SEMESTER B.Tech. (BME) DEGREE END SEM EXAMINATIONS, NOV/DEC 2015

SUBJECT: BIOMECHANICS (BME 2104)
(REVISED CREDIT SYSTEM)
Tuesday, December 8th, 2015 : 9.00 am - 12.00 noon

TIME: 3 HOURS **ANSWER ALL THE QUESTIONS** **MAX. MARKS: 100**

1. (a) Calculate the blood vessel "wall shear stress" with the following details: blood vessel diameter = 80 μm and mean blood flow velocity = 30 mm/sec. [2]

   (b) Write about Pure shear and Simple shear of RBC membrane. [4]

   (c) Prove that the blood is an example for Casson fluid by obtaining its plot. [6]

   (d) What is the response of the viscosity of: [3+3+2]

   (i) Ringer's solution with RBCs and Defibrinated blood to various shear rates.

   (ii) Deoxygenated RBCs and normal RBCs (suspended in plasma separately) to particle volume fraction.

   (iii) Blood to temperature.

   Provide graphical representation for all the three sections and explain (separately).

2. (a) Estimate the Reynolds number for blood flow in an arteriole. The diameter of the arteriole is 0.008 cm, the mean blood flow velocity in the arteriole is 3 cm/sec and the blood density is 1060 kg/m^3. [2]

   (b) How does the RBC's deformability affect the blood's viscoelasticity? [4]

   (c) Differentiate Non-Newtonian fluid flow from Pulsatile fluid flow. [6]

   (d) Derive the differential equation for the mechanical model, which responds well with the creep function and not the relaxation function. Find out the response of that mechanical model to stress relaxation, creep and also to periodic excitation. [8]

3. (a) If a person has total lung capacity of 6 litres and the volume of air left in the lungs at the end of expiration and maximum expiration are 3.5 litres & 1.2 litres respectively, then find the Vital Capacity and Expiratory Reserve Volume of the person? [2]

(b) What is "Reverse of Fahraeus-Lindquist effect"? How do you calculate the resistance of RBCs in microvessels using this effect? [4]

(c) Draw the general stress-strain of a solid and explain it in detail. [6]

(d) Explain the design principles of prosthetic heart valves. Also, describe the causes of failure of the prosthetic heart valves. [8]

4. (a) Write about the respiratory disease which does not affect the compliance of the lung but increases the expiratory resistance. [2]

(b) How do you assess and quantify the degree of skin hardness? [4]

(c) Are there any muscles directly attached to the lungs to aid with respiration? If so, then how? If not, then explain the mechanisms involved to aid with respiration. [6]

(d) Draw the structure of articular cartilage and explain the various zones present in the articular cartilage. [8]

5. (a) With a force of 11011 N exerted by the hip joint, calculate the cartilage stress and the change in length of cartilage on the femoral head. Assume that the cross-sectional area of the cartilage is 150 cm^2, that the elastic modulus for cartilage is 25 MPa, and that the cartilage thickness is 1.5 mm. Also assume that all of the forces acting on the femoral head are transmitted through the cartilage. [2]

(b) Justify that the strength of a bone declines with number of cycles during cyclic loading. [4]

(c) Provide two appropriate examples to justify that certain bones in the human body are designed to resist fracture. [6]

(d) Draw the human gait cycle, considering right lower extremity as the reference extremity. Also, define the phases and sub-phases of the gait cycle. [8]