Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University, Manipal – 576 104

VI SEMESTER B.Tech. (BME) DEGREE END SEM EXAMINATIONS, MAY 2016

SUBJECT: BIOFLUIDS & BIOMECHANICS (BME 320)
(REVISED CREDIT SYSTEM)
Friday, May 6th, 2016 : 2.00 - 5.00 pm

TIME: 3 HOURS **ANSWER ANY FIVE FULL QUESTIONS** **MAX. MARKS: 100**

1. (a) Calculate the wall shear stress of the blood vessel wall, if the diameter of blood vessel and mean velocity of blood flow are 80 μm and 30 mm/sec respectively. [2]

   (b) Plan a joint flexibility program for the biceps brachii muscle by considering the most efficient technique used for increasing the range of motion of the joint. [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 w.r.t. various shear rates.

   (ii) Deoxygenated RBCs and normal RBCs (suspended in plasma separately) w.r.t. particle volume fraction.

   (iii) Blood w.r.t. temperature.

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

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

   (b) How do the oscillatory measurements of viscoelasticity provide a more thorough picture of the physiological flow properties of blood? [4]

   (c) Draw the pressure-volume curves for a normal functioning lung and an excised human lung (separately) and compare them. [6]

   (d) Derive the differential equation for the viscoelastic model that is responsive to creep function and not to the stress-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 a total lung capacity of 6 litres and the volume of air retained 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) Is the Reynolds number above 1000 always indicates the presence of a turbulent blood flow and below 1000, a laminar blood flow? Comment on it. [6]

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

4. (a) A person having Hematocrit of 45% RBC and has 5 million RBCs in each mm^3 of blood, then estimate the Mean Corpuscular Volume (MCV) (in micron). [2]

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

(c) Is compliance of the most part of venous walls is far greater than that of most arterial walls at the same wall thickness? Comment on it. [6]

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

5. (a) Calculate the amount of torque generated at a joint when a muscle attaching to a bone 3cm from the joint exerts 100 N of tension at the angle of attachment of 30^o. [2]

(b) With appropriate examples, explain the disadvantages of multi-joint muscles. [4]

(c) Provide two appropriate examples to justify that certain type of 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]

6. (a) What is the reason behind the non-linearity of toe-region which is observed in the stress-strain curve of tendons and ligaments? [2]

(b) Justify that the strength and modulus of elasticity of a bone vary with the density or microstructure. [4]

(c) Differentiate parallel muscle fiber arrangement from penniform muscle fiber arrangement. [6]

(d) Explain how does the frequency of stimulation increases the generation of muscle force? [8]