MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institution of Manibal University

III SEMESTER B.Tech. (BME) DEGREE END SEM EXAMINATIONS NOV/DEC 2016 SUBJECT: BIOMECHANICS (BME 2104) (REVISED CREDIT SYSTEM)

Tuesday, 6th December 2016, 9 to 12 noon

TIME: 3 HOURS

MAX. MARKS: 100

Instructions to Candidates:

1. Answer all FIVE full questions.

2. Draw labeled diagram wherever necessary.

- (a) A person has Hematocrit of 45% RBC and has 5 million RBCs in each mm³ of 02 blood. Estimate the Mean Corpuscular Volume (MCV) (in micron).
 - (b) Write about the forces that act on the red blood cells that reach a junction where the blood vessel bifurcates in to branches of equal diameters.
 - (c) Define "peripheral resistance" to blood flow in a vascular tree. Also, explain about 06 the "seat" of vascular resistance.
 - (d) Estimate the permeability of the capillary wall for a given molecule and also explain the role of capillaries in the delivery of molecules to a tissue space.
- 2. (a) What is the standard value of viscosity of saliva and of the synovial fluid in the knee joint? Graphically represent the changes that occur in their viscosities w.r.t the shear rate.
 - (b) Estimate the "wall shear stress" on the blood that is placed in a concentric cylinder viscometer. The width of gap between inner and outer cylinders is 1 mm and the radius of inner cylinder is 30 mm. The outer cylinder rotates with an angular velocity of 60 rpm.
 - (c) Draw the curves for shear stress vs. shear rate of the following fluids and explain 06 their rheological behavior.
 - (i) Blood(ii) Bingham plastic(iii)Polymer solutions(iv)Plasma
 - (d) What is the response to harmonic variation of the mechanical model (most **08** efficient) for viscoelastic fluids?

3.	(a)	How do you calculate the work done by the heart? Provide examples to show the factors that increase the work load of the heart.	02
	(b)	Explain how the time-constant of lung is analogous to the time-constant of an RC electrical circuit?	04
	(c)	(i) A patient has cardiac output of 4.2 litres/min, heart rate of 84 beats/ min and blood volume of 5 litres. Find out the stroke volume, mean circulation time and the mean velocity in the aorta having a diameter of 32 mm.	04+02
		(ii) Find the inspiratory reserve volume for a patient with a total lung capacity of 7 L, a functional residual capacity of 2.7 L, and a tidal volume of 500 mL?	
	(d)	Compare laminar blood flow and turbulent blood flow.	08
4.	(a)	Why the soft tissues are called "Pseudoelastic"?	02
	(b)	Write about the various spatial parameters of a human gait cycle.	04
	(c)	Considering the Young's moduli for long bone, dentin and meniscus to be 30,000, 10,000 and 200 MPa respectively, answer the following:	06
		(i) What is the strain-energy required to deform each of the material to a strain of 0.1% ?	
		(ii) How much of strain-energy is stored in each of the material, if each of them is exposed to a stress of 30 MPa?	
	(d)	How do you perform a compression test on a cartilage to measure its compressive stiffness?	08
5.	(a)	What are the basic factors that need to be considered while designing a replacement for bone?	02
	(b)	Calculate the amount of torque generated at a joint when a muscle is attached to a bone at a distance of 3cm from the joint. The muscle exerts 100 N of tensile force at the angle of muscle attachment of 30° to the bone. Also, calculate the effective minimal cross-sectional area of the muscle.	04
	(c)	Explain how the frequency of stimulation increase the generation of muscle force?	06
	(d)	Differentiate parallel muscle fiber arrangement from penniform muscle fiber	08

arrangement.