Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

III SEMESTER B.Tech. (BME) DEGREE END SEM EXAMINATIONS NOVEMBER 2017
SUBJECT: BIOMECHANICS (BME 2104)
(REVISED CREDIT SYSTEM)
Tuesday, 28th November 2017: 9 AM to 12 NOON

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

Instructions to Candidates:

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

1. (a) Calculate the resistance to blood flow within the descending aorta and the inferior vena cava. Assume that the pressure difference between the distal portion of the aortic arch and the iliac artery is 20 mmHg. The pressure difference within the inferior vena cava is 3 mmHg. Assume that the flow-rate through both blood vessels is 4.5 L/min. 02

(b) Define compressive stress and the corresponding strain. Provide an example to explain how the human body is subjected to the compressive stress (internally). 06

(c) Explain the relationship between the cross-sectional area of blood vessels in the vascular tree with respect to the velocity of blood flowing through the blood vessels. 06

(d) Write about the characteristics of RBCs under the following circumstances: 06

(i) The blood is allowed to stagnate.

(ii) The blood flows at low shear rate.

(iii) The blood flows at high shear rate.

2. (a) What will be the 'mean corpuscular hemoglobin concentration', if the concentration of hemoglobin is 15 gm per 100 ml of whole blood and the hematocrit is 0.45? 02

(b) Discuss the human body fluid whose viscosity decreases irrespective of the increase in the fluid shear-rate. 06

(c) What are the pressure and volume reservoirs of the vascular tree? Explain why are they called so? 06

(d) Explain how the venous blood is carried from the feet to the heart, in the case of a person standing upright and also while walking. 06

3. (a) Calculate the vital capacity for a person with a total lung capacity of 7 L and a residual volume of 1.5 L. 02

(b) Explain the impact that is caused due to the usage of prosthetic heart valves on the endothelium which is present in the blood vessels. 06

(c) Using the Laplace law, explain the physical aspects of the alveoli. 06

(d) How are the collagen, elastin and reticulin fibers oriented in the dermal region of the skin? What is the response of the collagen fibers to the uniaxial stretch? 06

4. (a) What is the relationship between cadence and step length until you reach a velocity of 7 m/s while walking, and also beyond the velocity of 7 m/s? 02

(b) Draw the cross-section of the middle-section of a ligament, and explain its structure. 06

(c) Explain how the cancellous bone is able to withstand more load in spite of being highly porous. 06

(d) When a sample of bone is placed under increasing tension, its strain increases linearly at the beginning and then more rapidly, just before it breaks in to two at about 120 N/mm^2. The corresponding strain at the maximum stress is about 0.015. 06

(i) Calculate the maximum tension the bone can withstand with a cross-sectional area of 4 cm^2 just prior to fracture.

(ii) Determine the extent of elongation of bone (35 cm long) which would occur under the maximum tension.

(iii) Calculate the stress on this bone if a tensile force of 10^4 N were applied to it. How much would this bone lengthen?

5. (a) When the arm is in the horizontal position (laterally flexed to 90^o), the medial deltoid muscle is attached to the humerus bone at an angle of 15^o. Calculate the rotary and the stabilizing components of the muscle force, when the total muscle force is 500 N. 02

(b) Compare the various types of skeletal muscle tension. 06

(c) With an appropriate example each, explain active and passive insufficiency. 06

(d) Differentiate slow twitch muscle fibers from the fast twitch muscle fibers. 06