Question Paper

Exam Date & Time: 22-May-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B TECH BIOMEDICAL ENGINEERING BME 2251 BIOMECHANICS MAY JUNE 2023

BIOMECHANICS [BME 2251]

Marks: 50 **Duration: 180 mins.**

Descriptive

Answer all the questions. Section Duration: 180 mins

Answer All questions

1A)	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.	(4)
1B)	Apply the physical principle of cardio-vascular physiology to determine 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.	(3)
1C)	Apply Laplace law to explain the physical aspects of the alveoli.	(3)
2A)	Deduce the differential equation for the viscoelastic models and compare their responses to stress relaxation, creep and to periodic excitation.	(5)
2B)	Compare the mechanical properties of cortical bone with trabecular bone	(3)
2C)	Describe the functions performed by the skeletal muscle.	(2)
3A)	a. Explain the procedure followed to stretch the gastrocnemius muscle using the Proprioceptive Neuromuscular Facilitation stretching routine. b. Describe as to how the muscle spindles and the golgi tendon organs influence the effectiveness of a stretching exercise.	(4)
3B)	Compare the different types of pressure differences that play a role in micro vessels. Provide explanation with suitable mathematical expressions.	(3)
3C)	Consider the Young's moduli for long bone, dentin and meniscus to be 30,000, 10,000 and 200 MPa respectively. i. Calculate the strain energy required to deform each of the material of 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?	(3)
4A)	Illustrate the cross-section of the middle section of a ligament and explain its structure	(3)
4B)	Calculate the height of the center of mass above its starting height during a squat jump based on the following information: body weight = 670 N, total vertical force = 788 N and the time of force application = 0.9 sec.	(3)
4C)	Differentiate between internal and external work done, associated with the biomechanics of human	(4)

movement.

5A) Illustrate with an example the force couple. (4)

5B) Derive the relationship between linear and angular acceleration with suitable mathematical expressions and characteristics. (3)

5C) At the instant of takeoff, a 60 kg diver's angular momentum about his transverse axis is 20 kg.m^2/s. His radius of gyration about the transverse axis is 1.0 m at this instant. During the dive, the diver tucks and reduces his radius of gyration about the transverse axis to 0.5 m. (3)

a. At takeoff, calculate the diver's angular velocity about the transverse axis.

b. After the diver tucks, calculate his angular velocity about the transverse axis.

c. What do you infer from a & b?

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