

الامتحان OPEN BOOK (مسموح بكل شيء)

Menoufia University
Faculty of Engineering
Shebien El-kom
Academic Year : 2014-2015



Subject : Bio-Mathematics
Time Allowed : 3 hours
Date : 30 / 5 / 2015
Department : Basic Eng. Sci.

Allowed Tables and Charts : All allowed (Open Book)

Answer all the following questions: [100 Marks]

Question 1 [20 Marks]

Write brief notes on the following topics:

1. Bioengineering.
2. Biomathematics (show the steps of constructing a mathematical model).
3. Biomechanics and Bio-fluid mechanics.
4. Bio-fluid mechanics, view point of blood flow.
5. Biomedical engineering and its new career areas.
6. Biomaterials and its applications.
7. Bioenvironmental engineering.
8. Bioprocess engineering and tasks of bioprocess engineer.
9. Biosensors engineering.
10. Biophysics.

Question 2 [20 Marks]

If we consider a two-dimensional channel of uniform thickness $2d$, filled with a compressible viscous liquid. The walls of the channel are deformed in the shape of a traveling sinusoidal wave with constant amplitude a (Peristaltic motion). The vertical displacements of the upper and lower walls ($y = d$ and $y = -d$) are thus presumed to be η and $-\eta$, respectively, x and y are Cartesian coordinates with x measured in the direction of wave propagation and y measured in the direction normal to the mean position of the walls,

Write the mathematical model of this problem.

Question 3 [20 Marks]

A) If we consider an axi-symmetric cylindrical tube (pore) of radius R and length L filled with a compressible viscoelastic fluid (Maxwell model). We assume that an elastic wave induces a traveling wave on the wall (boundary) of the tube with the displacement (peristaltic motion). Note that the z -axis of the (r, ϕ, z) cylindrical coordinate system is directed along the axis of the tube.

Write the mathematical model of this problem.

- B) Write the mathematical model of the following :
1. Flow of blood in a stenosed (constricted) tube (with graph).
 2. Pulsatile blood flow through an artery.

Question 4 [20 Marks]

To observe the effects of an inserted endoscope on chime movement in small intestine, the mathematical model considers the flow of a Newtonian viscous fluid between the annular space (gap) of two concentric tubes; the outer tube (circular cylindrical) corresponds to the intestine (peristaltic wave) and the inner one (solid circular cylinder) to the endoscope. The flow is induced by sinusoidal peristaltic waves along the length of the outer tube wall (intestine wall).

1. Draw the geometry of the problem.
2. Write the mathematical model of this problem.

Question 5 [20 Marks]

Write a brief notes about the following items:

- Mathematical modeling of electrocardiographic applications.
- Electrical system of the heart and its mathematical modeling.
- Mathematical modeling of human sensory systems
- Preliminary Modeling for Intra-Body Communication.
- Signal transmission through human muscle for implantable medical devices using galvanic intra-body communication technique.
- Electrical impedance of human skin and tissue alterations: mathematical modeling and measurements.

This exam measures the following ILOs											
Question Number	Q1	Q4			Q2	Q3-b			Q5	Q3-a	
Skills	Knowledge & understanding skills				Intellectual Skills				Professional Skills		

With my best wishes

Associate Prof. Dr. Islam M. Eldesoky