

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (BME)/SEM-8/BME-802/2010**

**2010**

**MODELING OF PHYSIOLOGICAL SYSTEM**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

**GROUP - A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for the following :  $10 \times 1 = 10$

i) The nature of urine in proximal tubule is

- a) Hypotonic
- b) Hypertonic
- c) Isotonic
- d) None of these.

ii) Integral equation models are used in

- a) non-parametric approach
- b) parametric approach
- c) modular approach
- d) none of these.



iii) In electrical analogue model of blood flow, flow is equivalent to

- a) voltage
- b) current
- c) resistance
- d) none of these.

iv) Most real system are

- a) non-linear
- b) linear
- c) partly linear & partly non-linear
- d) none of these.

v) Black box models are derived by applying

- a) input-output relationship
- b) internal functioning of the system
- c) fundamental laws
- d) none of these.



vi) Ligament is modeled by

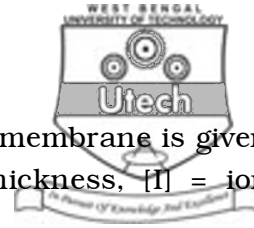
- a) Spring
- b) Dashpot
- c) Combination of Spring and Dashpot
- d) none of these.

vii) The Nernst potential of  $K^+$  is

- a) 77 mV
- b) - 57 mV
- c) - 59.5 mV
- d) 67 mV.

viii) Compartmental models are not used to describe

- a) Blood flow distribution
- b) Temperature distribution
- c) Neural network distribution
- d) None of these.



ix) The ionic diffusion (F) across the cell membrane is given by [ Fick's law, dx = membrane thickness, [I] = ion conc., D= diff. coeff. ]

a)  $F = D^2 \frac{d^2 [I]}{dx}$

b)  $F = -D \frac{d [I]}{dx}$

c)  $F = D \frac{dx}{d [I]}$

d) None of these.

x) The Nernst potential for a particular cation is calculated by the equation [ e = conc. of extra cellular fluid, i = conc. of intra cellular fluid ]

a)  $E_x = \frac{RT}{q} \ln \frac{[x^+]_e}{[x^-]_i}$       b)  $E_x = \frac{RT}{q} \ln \frac{[x^+]_i}{[x^-]_e}$

c)  $E_x = \frac{RT}{q} \ln \frac{[x^+]_e}{[x^+]_i}$       d)  $E_x = q RT \ln \frac{[x^+]_e}{[x^-]_i}$

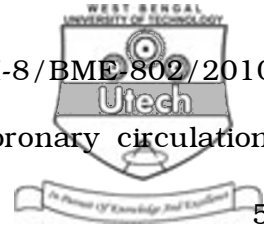
**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.      3 × 5 = 15

2. Write is mathematical modeling ? Why are mathematical models useful in medical field ?      2 + 3

3. What do you mean by black box and building block approach of a modeling system ? What is compartmental model ?      3 + 2



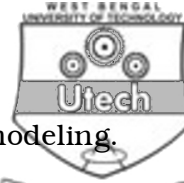
4. Briefly explain about the modeling of coronary circulation with transfer function. 5
5. How do you measure the renal blood flow ? Write down the equation for renal blood flow. 4 + 1
6. Explain briefly about the time invariant and time varying systems for physiological modeling with example. 5
7. Briefly describe the electromotive, resistive and capacitive properties of cell membrane. 5

**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following. 3 × 15 = 45

8. Derive an expression for solute transfer between different compartment of a physiological system. Describe the model of Henle's loop for NaCl transport. 5 + 10
9. Briefly explain about the different types of nonlinear model with example. Why are model specification and estimation important is successful modeling ? Describe the technique of linearization for nonlinear system. 5 + 5 + 5



10. a) Draw the schematic diagram of EMG – modeling. 5
- b) Describe the Huxley's mode of Isotonic muscle contraction. 5
- c) Consider a section of artery shown in the figure of length 6 cm, diameter 0.5 cm. The vessel wall has a thickness of 0.4 mm. Calculate the electrical equivalent of this segment of blood vessel.

Use blood velocity  $\eta = 0.04 \text{ g. cm}^{-1} \cdot \text{s}^{-1}$ ;  $\rho = 1 \text{ gcm}^{-3}$ ;  
Young's modulus of arteries  $E = 2 \times 10^6 \text{ g. cm}^{-1} \text{ s}^{-2}$

11. a) Describe about the significance and importance of the mathematical modeling. 5
- b) What do you mean by model specification and model estimation ? 4
- c) Explain about the electrical analogue model of a blood vessel. 6



12. (a) Briefly describe the model of strength duration curve of skeleton muscle. 8

(b) Briefly explain about the counter current model of urine formation. 7

13. What is nerve action potential ? How is it developed ? Draw and briefly discuss about the electrical equivalent circuit of the nerve membrane. Briefly discuss about the step response of 'potassium conductance' with its non-linear model.

3 + 7 + 5

