*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/B.TECH (BME)/SEM-8/BME-802/2012**

# 2012
# 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) Compartmental models are

a) lamped model b) continuous time model

c) both (a) and (b) d) none of these.

ii) Neural network model is an example of

a) black box model b) building block model

c) both (a) and (b) d) none of these.

iii) Differential equation models are used in

a) non-parametric approach

b) parametric approach

c) modular approach

d) none of these.

iv) For voltage clamp experiment by Hodgkin and Huxley, the term Vc is referred as

a) constant voltage b) clamp voltage

c) voltage component d) none of these.

v) The nature of urine in proximal tubule is

a) Hypotonic b) Hypertonic

c) Isotonic 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 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.

viii) The Nernst potential for a particular cation is calculated by the equation [$e$ = conc. of extra cellular fluid, $i$ = conc. of intracellular 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) $E_x = qRT\ ln \frac{[x^+]_e}{[x^-]_i}$.

ix) Compartmental models are not used to describe

a) blood flow distribution

b) temperature distribution

c) neural network distribution

d) none of these.

x) CMAP is
   a) Compound Molecular Actin Potential
   b) Compound Muscle Action Potential
   c) remCollagen Mapping
   d) Collateral Mapping of Action Potential.

## GROUP – B

### ( Short Answer Type Questions )

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

2. Describe the model of whole neuron step by step and also apply the Kirchhoff's current law for each step.
3. What is mathematical modeling ? Why mathematical models are useful in medical field ? 1 + 4
4. What do you mean by black box and building block approach of a modeling system ? What is compartmental model ? 2 + 2 + 1
5. Briefly explain about the modeling of coronary circulation with transfer function.
6. Explain briefly about the time invariant and time varying systems for physiological modeling with example.
7. Briefly describe the electromotive, resistive and capacitive properties of cell membrane.

## GROUP – C

### ( Long Answer Type Questions )

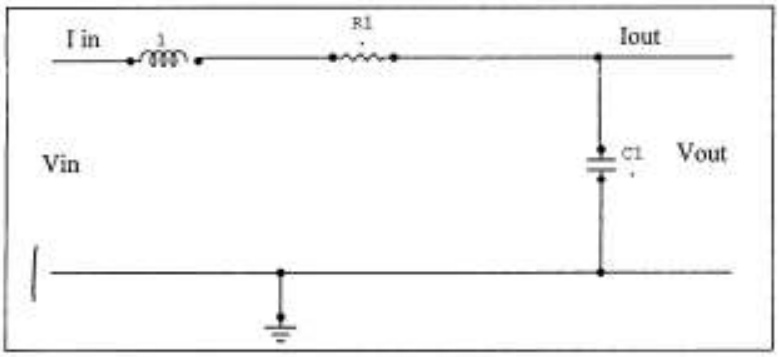
Answer any *three* of the following. 3 × 15 = 45

8. Derive an expression for solute transfer between different compartment of a physiological system. Describe the model of Henle's loop for NaCl transport. 8 + 7
9. What do you mean by the term immune response ? Briefly discuss the linearized model of the immune response to germ cells, plasma cells and antibody. How do you measure the renal blood flow ? Write down the equation for renal blood flow. 2 + 7 + 6

10. a) Draw the schematic diagram of EMG-modeling. 5

b) Explain about the electrical analogue model of a blood vessel. 5

c) Consider a section of artery shown in 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 $\eta = 0.04\ g.cm^{-1}.s^{-1}$, $\rho = 1 g.cm^{-3}$, young's modulus of arteries $E = 2x\ 10^{6}\ g.cm^{-1}s^{-2}$ 5




11. Briefly explain about the different types of non-linear model with example. Why model specification and estimation are important in successful modeling ? Describe the technique of linearization for a non-linear system. 5 + 5 + 5

12. 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. 2 + 2 + 6 + 5

13. 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