



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH/BME/SEM-8/BME-802/2013

2013

MODELLING 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 answer of the following : 10 × 1 = 10
 - i) In electrical analogue model, pressure changes is considered as
 - a) Current changes
 - b) Resistance changes
 - c) Potential changes
 - d) None of these.
 - ii) The nature of urine in proximal tubule is
 - a) Hypotonic
 - b) Hypertonic
 - c) Isotonic
 - d) None of these.
 - iii) Ligament is modelled by
 - a) Spring
 - b) Dashpot
 - c) Combination of spring and dashpot
 - d) None of these.



- iv) The cell membrane potentialwith distance.
- a) increases b) decreases
c) remains constant d) none of these.
- v) Which one is the correct one for muscle force (M.F) ?
- a) Active M.F = Stimulated M.F. + Passive M.F
b) Active M.F = Stimulated M.F – Passive M.F
c) Active M.F = Stimulated M.F /Passive M.F
d) None of these.
- vi) If the capacitive current of a cell membrane I_c , membrane capacitance C_m and change of membrane potential with time (t) is $\frac{dv_m}{dt}$, then what will be the membrane current (I_c) expression ?
- a) $I_c = \frac{dv_m}{dt} \frac{1}{C_m}$ b) $I_c = C_m \frac{dv_m}{dt}$
c) $I_c = \frac{dv_m}{dt}$ d) None of these.
- vii) The Nernst potential of Na^+ is
- a) 77 mV b) – 57 mV
c) 67 mV d) – 59.5 mV.
- viii) In the modelling of blood flow in circulatory system, the reference or ground point is chosen as
- a) Left atrium b) Right atrium
c) Left ventricle d) Right ventricle.
- ix) MVC is
- a) Minimum voluntary contraction
b) Moderate voluntary contraction
c) Maximum voluntary contraction
d) none of these.



x) The substances which are capable of eliciting an immune response are called

- | | |
|----------------|-----------------|
| a) antigen | b) antibody |
| c) lymphocytes | d) plasma cell. |

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

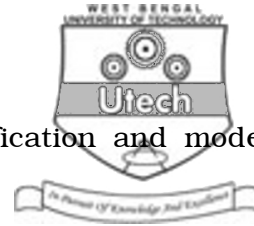
2. Explain the recording technique of nerve action potential.
3. Classify different types of non-linear model with example.
4. Explain the purpose and characteristics of physiological modelling.
5. Describe the linearization process of a nonlinear model.
6. Briefly describe the "voltage clamp experiment" done by Hodgkin and Huxley.
7. Briefly explain about the electrical analogue model of blood flow.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

8. a) Write down the cross-bridge theory of muscle contraction.
b) Briefly explain about the Huxley's model of isotonic muscle contraction. $6 + 9$
9. a) Describe about the significance and importance of the mathematical modelling.



- b) What do you mean by model specification and model estimation ?
- c) Explain about the electrical analogue model of a blood vessel. 5 + 4 + 6
10. a) Briefly describe the model of strength duration curve of skeleton muscle.
- b) Briefly explain about the counter current model of urine formation. 8 + 7
11. With a block schematic, describe the flow of blood in human circulatory system. Describe briefly about the model of coronary circulation. Consider a section of arteriole of length 6 cm, diameter 0.1 cm and vessel wall thickness of 0.05 mm. Calculate the electrical equivalent of this segment of blood vessel. Use blood viscosity = 0.04 g.cm^{-1} , blood density = 1.0 g/cc , Young's modulus = $2 \times 10^6 \text{ g.cm}^{-1}\text{s}^2$. 5 + 5 + 5
12. What is compartmental model ? Derive an expression for solute transfer between different component of a physiological system. Write down the four different applications of compartmental model in biomedical field. Briefly explain the four compartment model of bone cell formation. 2 + 8 + 2 + 3
13. What do you mean by immune response ? Describe the linearized model of immune response to germ cells, plasma cells and antibody. Discuss about the twitch and force frequency curve of a muscle. 2 + 7 + 6

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