

Invigilator's Signature :

Name :

CS/B.TECH(BME)/SEM-8/BME-802/2011 2011

MODELING OF PHYSIOLOGICAL SYSTEM

Time Allotted : 3 Hours

Full Marks : 70

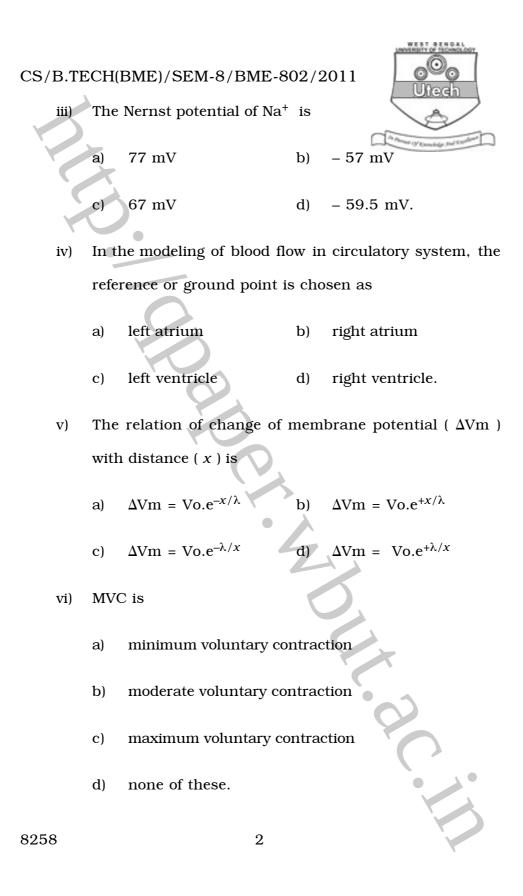
The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable.

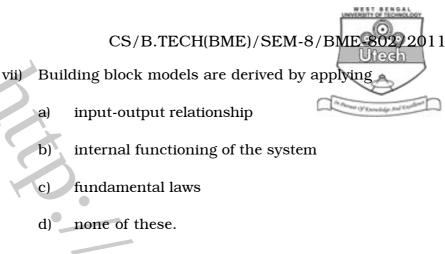
GROUP – A

(Multiple Choice Type Questions)

- 1. Choose the correct answer of the following : $10 \times 1 = 10$
 - Differential equation models are used in i)
 - Parametric approach a)
 - Non-parametric approach b)
 - Modular approach c)
 - d) Connectionist approach.
 - In electrical analogue model, pressure changes are ii) considered as
 - current changes resistance changes a) b)
 - voltage changes d) none of them. c)

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- viii) The cell membrane potential with distance
 - a) increases b) decreases
 - c) remains constant d) none of these.
- ix) 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.
- x) 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)
$$I_c = \frac{dv_m}{dt} \frac{1}{C_m}$$

c) $I_c = \frac{dv_m}{dt}$

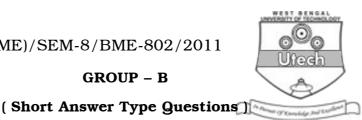
 $I_c = C_m$ b)

d) None of these.

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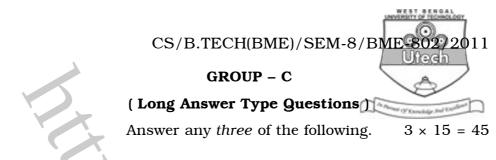


 $3 \times 5 = 15$

GROUP – B

Answer any *three* of the following.

- 2.What do you mean by model specification and model estimation?
- 3. Describe the linearization process of a non-linear model.
- Briefly explain the electrical analogue model of blood flow. 4.
- Explain the recording technique of nerve action potential. 5.
- What are the events which must be considered for 6. developing a linearized model of immune response ? Write down the system equations for the immune response.
- Briefly describe the "voltage clamp experiment" done by 7. Hodgkin and Huxley.



- 8. a) Write down the cross-bridge theory of muscle contraction.
 - b) Briefly explain Huxley's model of isotonic muscle contraction.
 6 + 9
- 9. With a block schematic, describe the flow of blood in the human circulatory system. Describe briefly 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 vicosity = 0.04 g.cm⁻¹, blood density = 1.0 g/cc, young modulus = 2×10^6 g. cm⁻¹ s².

5 + 5 + 5

10. What is compartmental model ? Derive an expression for solute transfer between different components 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.

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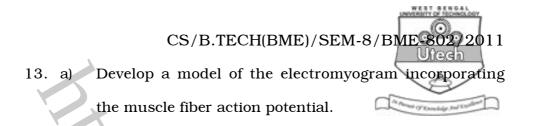
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CS/B.TECH(BME)/SEM-8/BME-802/2011 11. What do you mean by immune response ? Describe the linearized model of immune response to germ cells, plasma cells and antibody. Discuss the twitch and force-frequency curve of a muscle. 2 + 7 + 6

- Briefly discuss the purpose of physiological system 12. a) modelling.
 - b) Give an experimental data set that can be modelled as a first order step response. Describe how the amplitude constant and time constant may be calculated for the following two cases :

 - i) $c [1 e^{-t/\tau}] . u(t)$ ii) $[c + e^{-t/\tau}] . u(t)$
 - With an electrical analogue diagram discuss in brief the c) following :
 - Fluid flow through a rigid tube i)
 - Fluid flow through an elastic tube. ii)

4 + (3 + 3) + (2 $\frac{1}{2}$ + 2 $\frac{1}{2}$)



b) Discuss the effect of Muscle fiber conduction velocity.

c) Discuss the frequency analysis and power spectrum in electromyogram and enumerate the physiological significance. 6 + 3 + 6

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