BT 301: Biophysics **MIDSEM 15 Sep 24** Instr: R. Swaminathan

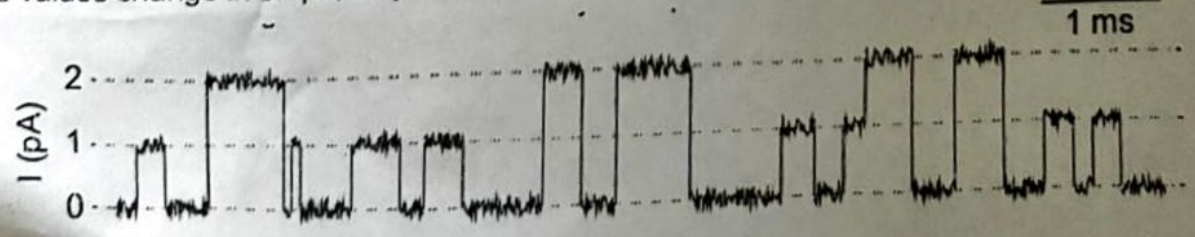
Total marks = 30. Section A carries 12 marks; Section B carries 18 marks

SECTION A (2 x 6 = 12)

1. Name two torsion angles in DNA each for a) Backbone rotations b) Sugar ring torsion.
2. Draw the Deoxyribose sugar ring with numbered C atoms and -OH positions
3. Explain why is the K^+ channel is 100 times more permeable to K^+ than Na^+.
4. Draw the structure of one purine and one pyrimidine base and highlight atom linked to sugar.
5. How do bacteria regulate fluidity in their membranes?
6. Name the three domains in the structure of Sarcoplasmic Reticulum Ca^{2+} ATPase and briefly describe their functions.

SECTION B (3 x 6 = 18)

7. Arrange the following processes involved in transmission of ACTION POTENTIAL in the correct time sequence they occur:
   a. Acetyl choline receptors are inactivated
   b. Acetyl choline binds to acetyl choline receptor on post-synaptic membrane
   c. Voltage sensing K^+ channels open, K^+ ions flow out of cell
   d. Voltage sensing Na^+ channels inactivated by ball chain mechanism
   e. Voltage sensing Na^+ channels open, Na^+ ions flow inside cell. Membrane potential rises rapidly.
   f. Na^+ ions flow inside cell; K^+ ions flow out of cell
   g. Membrane potential drops rapidly
   h. Voltage sensing K^+ channels inactivated by ball chain mechanism
8. Explain the molecular mechanism involved in rapid transport of K^+ in potassium channels and how this channel opens in response to voltage.
9. Contrast three structural feature parameters of A-DNA with B-DNA
10. With regard to transport of ions and polar molecules across the membrane, illustrate the functional features of PUMPS and CARRIERS with examples.
11. A student obtained the following current trace from a very small patch of membrane with objective of measuring ION CONDUCTANCE. Describe name of this technique. Explain why the values change in steps; why maximum current is 2 pA; what more does this trace reveal?



12 A) Consider a neuronal cell with volume 12,000 μm^3 and a surface area of 10,000 μm^2. If during opening of Na^+ channel, 100,000 Na^+ ions flow inside the cell per ms per μm^2 area, calculate by what percentage does the Na^+ ion intracellular concentration [14 mM] change in 1 ms due to action potential.

12 B) Calculate the equilibrium membrane potential, use T = 37 deg C.

a. For Na^+ ($[Na^+]_{in}$ = 14 mM; $[Na^+]_{out}$ = 143 mM;)

b. For K^+ ($[K^+]_{in}$ = 157 mM; $[K^+]_{out}$ = 4 mM;)