GANPAT UNIVERSITY

B.Tech. Semester VI (BM&I), Regular May-June Examination 2013.

2BM 602 Biopotential and Recorders

Time:- 3 Hours **Marks:- 70**

Instructions:

1. **Answer to the questions must be written in separate answer books.**
2. **Figure to the right indicate marks.**
3. **Assume data, if needed.**
4. **Conventional terms / notations are used.**
5. **All the questions are compulsory.**

SECTION-I

Q.1 **[12]**

(a) Draw the electrical equivalent circuit of a cell membrane with K^+, Na^+ and Cl^- channels. Give the reason for choosing the particular orientation of the battery polarity for each.

(b) What is Nernst potential? Derive the Nernst potential for Sodium and Potassium ions. (Assume necessary concentration values for both ions)

OR

Q.1 **[12]**

(a) In a cell, on increasing the permeability of an ion, how will the following parameters get affected? a) Membrane potential b) Equilibrium potential of the ion. c) Electrochemical driving force on the ion d) Current carried by the ion. Give reasons for your answers.

(b) In a nerve cell, at the peak of the action potential, P_{Na} is observed to have increased to 300 times its value at rest, P_K not to have changed, and P_{Na}/P_K to be 10. Take $[Na]_o$=120 mM, $[Na]_i$=10 mM, $[K]_o$=5 mM, $[K]_i$=140 mM, temperature to be 27 ^oC, R=8.31 J/(K-mole), and F=96,500 Coul/mole. What was the resting membrane potential of the cell? What was the membrane potential at the peak of the action potential?

Q.2 [11]

(a) Explain the process of propagation of action potential in nerve cells.

(b) Draw and explain the generation of an action potential process in accordance with the sodium and potassium conductance graph.

OR

Q.2 [11]

(a) Explain the chemical transmission process occurs at neuromuscular junction.

(b) What is GHK equation? Explain the physiological significance of the equation.

Q.3 [12]

(a) Derive an equation for potassium conductance with estimation of associated parameters.

(b) Define the passive transport and active transport phenomena for biological fluids.

SECTION – II

Q.4. [12]

(a) Write a short note on rhythmic potential generated by brain.

(b) What do you understand by ECG? Draw and explain the lead configuration of ECG.

OR

Q.4. [12]

(a) What is an instrumentation amplifier? Draw the circuit diagram of instrumentation amplifier of gain 1000.

(b) Define the factors that determine the rising phase and falling phase of an action potential.

Q.5. [11]

(a) The resting potential of a cell is determined by 3 ions A^+, B^+ and C^- ions. The equilibrium potential of A^+, B^+ and C^- ions are -30 mV, +30 mV and +90 mV. Given the ration of conductance for A^+ and C^- is equal to 1, what will be the direction of change of membrane potential on doubling B^+ conductance?

(b) Write a short note on EOG.

OR

Q.5

(a) Draw and explain the different phases of action potential in skeletal muscles. [11]

(b) The chemical activity of an ion in solution is a more accurate estimate of its availability (for processes such as diffusion and pumping, for instance), than its concentration. The measured intracellular chloride activity of smooth muscle cells using Cl^- sensitive intracellular microelectrodes, and found it to be 45 mM. The following information is also available:
Resting membrane potential = -66 mV; extracellular Cl^- activity = 110 mM.

(i) Substituting activities for concentrations, calculate E_{Cl} using R=8.314 J/K-mole, T=37 ^oC (since the experiments were done on mammalian (guinea-pig) muscle), and F=96,500 Coul/mole.

(ii) Is Cl at equilibrium across the smooth muscle cell membrane? If not, what would require to be the value of intracellular chloride in order for Cl to be at equilibrium?

(iii) Suppose a neurotransmitter acts on the smooth muscle cell membrane to open channels that are specifically permeable to Cl. Will the membrane potential of the cells change? In which direction?

Q.6.

(a) [12]

1. Nernst potential of an ion is

(a) The membrane potential beyond which the flux of the ion across the membrane becomes opposite in direction.
(b) The membrane potential at which changing the permeability for the ion produces no change in flux.
(c) The membrane potential at which there is no net passive movement of the ion across the membrane.
(d) Only (a) and (c)
(e) All of the above
(f) None of the above

2. A certain cell has a membrane potential of -50 mV. The equilibrium potential of one of its ions is + 30 mV. In the Hodgkin- Huxley model, which of the following is assumed not to change on changing the permeability of the ion?

(a) Membrane potential
(b)Equilibrium potential of the ion
(c) Electrochemical driving force on the ion
(d) Current carried by the ion
(e) All of the above
(f) None of the above

3. The sodium –potassium pump generates

(a) A net inward current associated with a net inward flux of K+ ions.
(b) A net outward current associated with a net outward flux of Na+ ions
(c) A net inward current associated with a net inward flux of Na+ ions.
(d) A net outward current associated with a net outward flux of K+ ions
(e) No net current

4. Which of the following quantity is NOT changed for an ion with change in its permeability.

(a) Direction of ionic flow
(b) Ionic flow rate
(c) All of the above
(d)None of the above

5. The entry of Calcium at axon endings triggers:

(a) Rise phase of action potential
(b) Neurotransmitter release at synapse
(c) Entry of Na+ into cell
(d) Entry of K+ into cell

(b) Draw and explain the setup of voltage clamp experiment. Discuss the ionic currents curves obtained at different clamp voltages.

-----END OF PAPER-----