

GANPAT UNIVERSITY
B.TECH SEM. VI BIOMEDICAL & INSTRUMENTATION ENGINEERING
REGULAR EXAMINATION MAY-JUNE - 2012

BME 601: BIOPOTENTIALS AND INSTRUMENTATION

TIME : 3 HOURS

TOTAL MARKS: 70

INSTRUCTION:

1. Write each section in separate answer books.
2. All questions are compulsory.
3. Draw figures, write equations and assume data wherever necessary.
4. Conventional terms / notations are used.
5. Figure to the right indicate marks.

Section - I

Q.1

- a) Derive Nernst potential equation. Calculate the Nernst potential for potassium ion if $[K^+]_i = 397$ and $[K^+]_e = 20$ at 25°C . [12] (5)
- b) Draw and explain the two compartment ionic system illustrating Donnan equilibrium. Explain giving equations how osmotic concentration can upset this equilibrium condition. (5)
- c) Define Reflex arc. Explain it briefly? (2)

OR

Q.1

- a) Determine the membrane potential V_m and the Nernst potential of each ion for following given concentrations at 37°C . Ignore chlorine ion channel. [12] (5)
 $[K^+]_i = 140 \text{ mEq/l}$ and $[K^+]_e = 4 \text{ mEq/l}$
 $[Na^+]_i = 14 \frac{\text{mEq}}{\text{l}}$ and $[Na^+]_e = 142 \text{ mEq/l}$
- b) Draw the electrical equivalent circuit and discuss the change in membrane potential V_m with distance when the current pulse is injected into the membrane. Write the related equations. (5)
- c) By what means the force of muscular contraction could be controlled? (2)

Q.2

- a) Draw and explain the setup of voltage clamp experiment. Discuss the ionic currents curves obtained at different clamp voltages. What is reverse potential? Give its equations. [11] (6)
- b) Draw figure and describe the procedure through which conduction velocity in peripheral nerve can be measured by stimulating motor nerve. (5)

OR

Q.2

- a) Discuss equations of G_K and G_{Na} as described by Hodgkin and Huxley. Draw and explain stylized waveforms of action potential incorporating time and voltage dependent conductance changes of active Na^+ and K^+ channels. [11] (6)
- b) Describe voltage gated sodium and potassium channels causing depolarization and repolarization of the nerve membrane with figures. What is absolute and relative refractory period and show them on action potential graph. (5)

Q.3 Write short note on (Any three)

[12]

- a) Effect of acetyl choline on post synaptic muscle membrane and its destruction
 - b) Skeletal muscle contraction
 - c) Cardiac muscle structure and its action potential
 - d) Propagation of action potential in nerve fiber
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Section – II

Q.4 [12]

- a) Explain characteristic problems associated with biomedical signals. (6)
- b) Give the difference between instrumentation amplifier and operational amplifier and its application with neat application diagram (6)

OR

Q.4 [12]

- a) Explain types of flash ADC with block diagram. (6)
- b) Application of computer in biomedical signal. (6)

Q.5 [11]

- a) Design a 2nd order low pass filter using sallen-key topology for 120Hz cutoff frequency. [Hint: design for Butterworth type] (6)
- b) What is EOG? Explain saccadic response of eye with its parameters. (5)

OR

Q.5 [11]

- a) Design a high pass filter for -40 dB/decade attenuation for frequency below 60Hz. (6)
- b) Explain ECG instrumentation system with Ten patient electrodes. (5)

Q.6 [12]

- a) Explain EEG instrumentation scheme with neat diagram. (4)
- b) Explain single slope ADC with its block diagram. (4)
- c) Explain QRS complex detection methods with its advantages. (4)

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