Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 41034

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth Semester

Computer Science and Engineering

OMD 551 – BASIC OF BIOMEDICAL INSTRUMENTATION

(Common to Computer and Communication Engineering/ Electrical and Electronics Engineering/ Electronics and Communication Engineering/ Electronics and Telecommunication Engineering/Information Technology)

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the four main factors involved in the movement of ions across the cell membrane in the steady-state condition?

2. Premature Ventricular Contractions (PVC) can be identified because

   (a) they arrive early.

   (b) the successive beat generated by SA node occurs at the normal time, and

   (c) the width of QRS is greater than 80 ms. Demonstrate an algorithm to detect and count PVCs based on these criteria.

3. List the main frequency bands of the human EEG waves.

4. With neat diagram explain Einthoven's triangle.

5. List the different amplifiers used for biophysical measurements.

6. Outline the limitations of Differential amplifier.

7. List the indirect methods of monitoring Blood Pressure.

8. Compare the methods used for the detection of volume (pulse) changes due to blood flow?

9. What are the different states the oxygen is carried in the blood?

10. Explain the working principle of colorimeter with block diagram.

PART B — (5 × 13 = 65 marks)

11. (a) Draw a typical lead II electrocardiogram and label all waves (P, QRS, T) and intervals. What are the electrical activities within the heart during each wave and interval?

Or

(b) We want to develop an electrical model for a specific biopotential electrode study in the laboratory. The electrode is characterized by placing it in a physiological saline bath in the laboratory, along with an Ag/AgCl electrode having a much greater surface area and a known half-cell potential of 0.233 V. The dc voltage between the two electrodes is measured with a very-high-impedance voltmeter and found to be 0.572 V with the test electrode negative. The magnitude of the impedance between the two electrodes is measured as a function of frequency at very low currents is shown in the Figure 11(b). From these data. What will be a circuit model for the electrode?

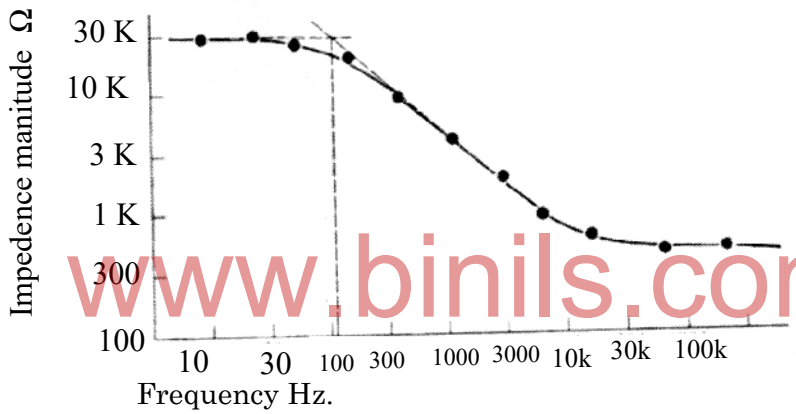

Figure 11(b)

12. (a) Demonstrate Bipolar and Unipolar ECG lead connections with neat diagrams.

Or

(b) Demonstrate the International 10-20 EEG system of the electrical activity of the brain from the scalp.

13. (a) With a neat circuit diagram explain the instrumentation amplifier used at the input stage of a medical amplifiers design.

Or

(b) With a neat block diagram explain the carrier amplifier used to obtain zero frequency response of the dc amplifier and the inherent stability of the capacitance coupled amplifier.

14. (a) If a mercury-manometer reading is taken at h mm below heart level, the reading is high due to the weight of a column of blood h mm high (this weight is r gh). Then find the compensation factor.

Or

(b) In a patient monitoring system, what is the provision to measure the respiration rate of a patient? Explain.

15. (a) A blood specimen has a hydrogen ion concentration of 40 nmol/liter and a P_{CO2} of 60 mm Hg. What is the pH? What type of acid-base abnormality does the patient exhibit? Explain.

Or

(b) Illustrate a method with block diagram to measure the optical absorption of a liquid sample.

PART C — (1 × 15 = 15 marks)

16. (a) An AgCl surface is grown on an Ag electrode by the electrolytic process. The current passing through the cell is measured and recorded during the growth of the AgCl layer and is found to be represented by the equation $I = 100mA\,e^{-t/10}$

(i) If the reaction is allowed to run for a long period of time, so that the current at the end of this period is essentially zero, then determine the amount of charge removed from the battery during this reaction.

(ii) Determine the amount (in grams) of AgCl, deposited on the Ag electrode's surface by this reaction.

The chloride electrode is now placed into a beaker containing 1 liter of 0.9 molar NaCl solution. Estimate the amount of AgCl dissolved.

Or

(b) Design the automatic blood pressure monitor based on the ultrasonic detection of arterial wall motion.

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