UNIVERSITY OF GHANA

BSC. ENGINEERING

FIRST SEMESTER EXAMINATIONS: 2016/2017

DEPARTMENT OF BIOMEDICAL ENGINEERING

BMEN 303: BIOINSTRUMENTATION (3 CREDITS)

INSTRUCTIONS:
ANSWER ALL QUESTIONS

TIME ALLOWED: TWO AND HALF (2½) HOURS

1.

a. State the type of electrodes used in the acquisition of the following biosignals: ECG, EEG, EMG. State two distinguishable characteristics of each signal and one clinical application. **(6 marks)**

b. State four characteristics of a bio-potential instrumentation system. **(4 marks)**

c. Draw a block diagram of a bio-potential amplifier. **(4 marks)**

d. What is motion artefact? Explain its effect in measuring bio-potentials. How is it reduced or eliminated? **(6 marks)**

2.

a. i. Explain why Differential amplifiers are suitable in measurement of ECG and EEG. **(6 marks)**

ii. What is meant by *common mode signal*? State three sources of common mode signal. **(4 marks)**

b. Design a non- inverting amplifier with a gain of 20dB and the input signal in the range of -1 V to + 1V. Your design should have the ability to deliver a maximum current of 100 mA through a resistive load RL. If all the current is to pass through the resistive load, what is the maximum value that RL can have. **(12 marks)**

c. Sketch and label the voltage transfer characteristics curve of an op-amp. **(3 marks)**

3.

a. A first order active high pass filter has a pass band gain of two and a cut-off corner frequency of 1 kHz. If the input capacitor has a value of 10 nF:

i. Calculate the value of the resistor at this cut-off frequency. **(3 marks)**

ii. What is the relationship between the gain resistors in the feedback network? **(3 marks)**

iii. Design this filter circuit using the results in i and ii. **(6 marks)**

iv. Sketch the frequency response curve of your design. **(3 marks)**

b. Describe the auscultatory method of Blood Pressure (BP) measurement. **(5 marks)**

c. What is the Mean Arterial Blood Pressure (MAP) and how is it estimated? What is its clinical significance? **(5 marks)**

d. Three patients A, B and C have their BP measured as 150/95 mmHg, 110/40 mmHg, and 83/50 mmHg respectively. Which patient has a better BP? Explain. **(5 marks)**

4.

a. i. What are ECG leads and the different types in a 12 standard lead system? **(6 marks)**

ii. Sketch a normal ECG wave form and identify the various waves. **(4 marks)**

iii. State the cause of each wave. **(6 marks)**

b. Determine the heart rate of the following ECG recorded per page (Figures 1, 2 and 3) with the standard scale as: vertical axis 10 mm = 1 mV and Horizontal axis 250 min = 1 second. **(9 marks)**

i.

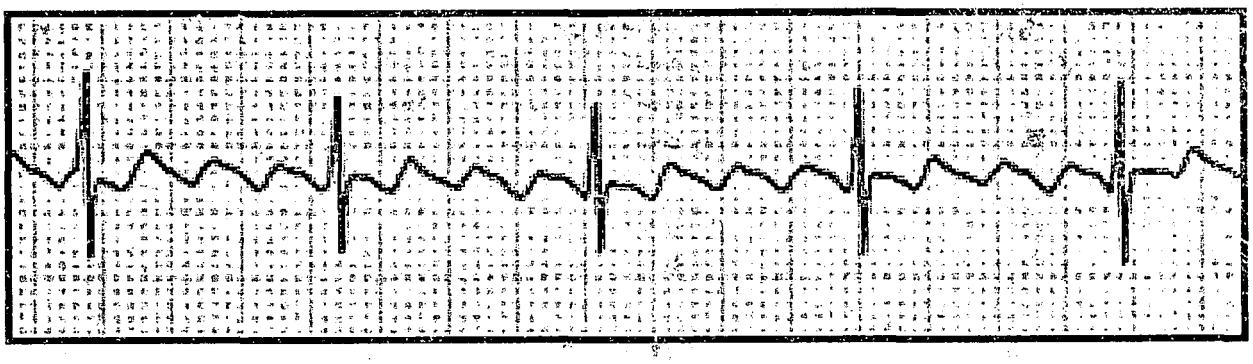

Figure 1

ii.

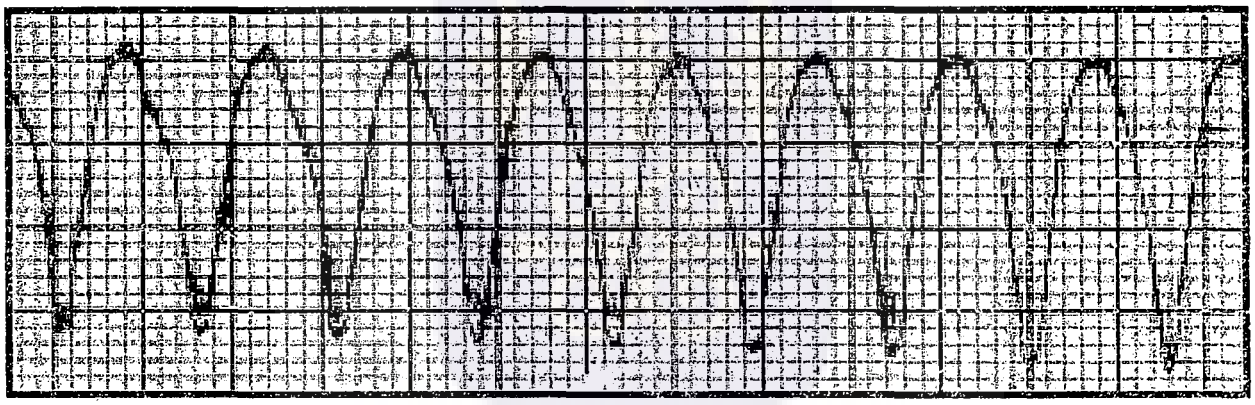

Figure 2

iii.

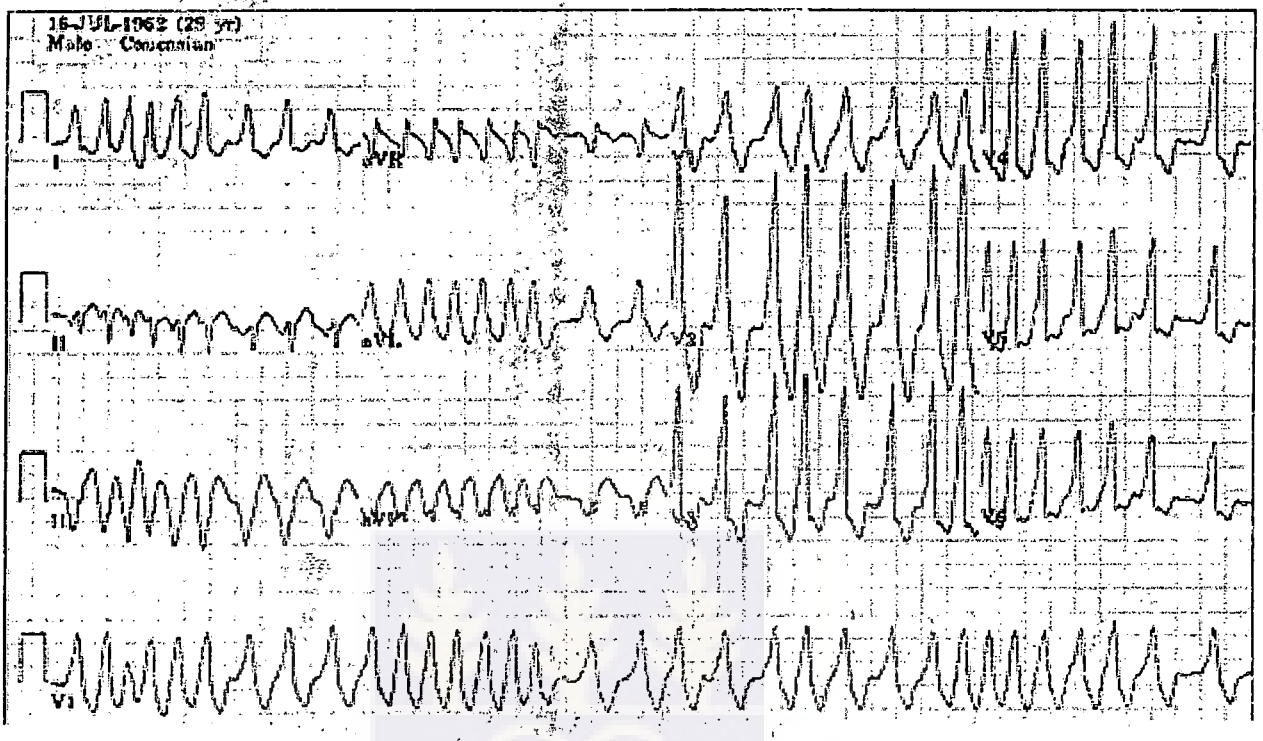

Figure 3