UNIVERSITY OF GHANA

BSC. ENGINEERING

FIRST SEMESTER EXAMINATIONS: 2017/2018

DEPARTMENT OF BIOMEDICAL ENGINEERING

BMEN 303: BIOINSTRUMENTATION (3 CREDITS)

INSTRUCTIONS:
ANSWER FOUR (4) QUESTIONS

TIME ALLOWED: TWO AND HALF (2½) HOURS

1.

a. Draw a well labeled diagram of an active high pass filter. **(5 marks)**

b. An active filter has an op-amplifier as one of its components. State three uses of the amplifier. **(3 marks)**

c. Sketch and label the frequency response curve of your diagram in 1a. **(4 marks)**

d. Design a non-inverting active low pass filter circuit that has a gain of 10 at low frequencies, a high frequency cut-off or corner frequency of 159 Hz and an input impedance of 10 kΩ. **(13 marks)**

2.

a. Mention five characteristics of ideal operational amplifier. **(5 marks)**

b. A physical operational amplifier is not an ideal amplifier, draw a well labelled equivalent circuit diagram of an operational amplifier? **(5 marks)**

c. Name three reasons why it is advantageous to include a negative feedback system in the design of a bio-amplifier. **(3 marks)**

d. Design a non-inverting amplifier that has a gain of - 4, if the total resistance used is 100 kΩ. **(12 marks)**

3.

a. Draw a block diagram of the instrumentation system used in EEG recording and briefly explain the function of each component. **(8 marks)**

b. Brain waves are classified into four groups. Sketch and name samples of the brain waves with their dominant frequency range. **(8 marks)**

c. Which one of the waves in 3b is the best known and most extensively studied? **(2 marks)**

d. Name five applications of EEG. **(5 marks)**

e. Name four sources of EEG artefacts. **(2 marks)**

4.

a. What is meant by the mean arterial pressure (MAP) and what is its clinical significance? **(4 marks)**

b. Three patients A, B and C have their blood pressure measured as 150/95, 110/40, and 83/50 respectively. Calculate each patient's MAP and comment on your results. **(9 marks)**

c. i. What is meant by slew rate? **(2 marks)**

ii. A 100 pF capacitor has maximum charging current of 150 μA. What is the slew rate? **(5 marks)**

iii. An operational amplifier has a slew rate of 2 V/μs. If the peak output is 12 V, what is the power bandwidth? **(5 marks)**

5.

a. In a tabular form or otherwise, mention **three biopotentials**, their sources, specifications, type of electrode used in measurement, source of error in measurement and selected applications? **(15 marks)**

b. High input impedance and low output impedance are needed in the design of bio-amplifiers. Explain. **(4 marks)**

c. What is the output voltage V_o for an input of 1.25 V in the circuit below? **(6 marks)**