



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MEDICAL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MEDICAL ENGINEERING

EBL 4403: BIOMEDICAL INSTRUMENTATION II. (PAPER 2)

END OF SEMESTER EXAMINATION

SERIES: NOVEMBER 2024 TIME: 2 HOURS. DATE: NOVEMBER 2024.

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt the compulsory question one and any other two.

Do not write on the question paper.

QUESTION ONE.

- (a)(i). Define a transducer and state the role they play in medical instrumentation systems.
- (ii). State the advantages of using active transducers instrumentation systems.
- (iii). Using a diagram, explain how a thermistor may be operated as a thermometer. **(9 Marks).**
- (b)(i). Define and explain the behavior of a bi-metallic strip.
- (ii). Name any applications of a bi-metallic strip.
- (iii). Draw and explain the operation of a simple temperature operated fan. **(12 Marks).**
- (c)(i). Differentiate between a thermocouple and a light dependent resistor, LDR.
- (ii). Mention any two merits and two demerits of using LDRs in constructing light intensity meters.
- (iii). A linear light dependent resistor, LDR which has a resistance of $20\text{ k}\Omega$ at zero light intensity and $200\text{ }\Omega$ at full bright light is connected in series with a 100Ω and a 100V DC power supply. Calculate the current and power dissipated across the fixed resistor at zero light and full brightness. **(9 Marks)**

QUESTION TWO.

- (a)(i). Differentiate between of a bio-sensor and an electrical sensor, hence explain the importance of sensors in measurements.
- (ii). Explain the meaning and the need of the following in bio-measurements systems.

(I). Electronics. (II). Display.

(ii). Explain need for human body blood pressure measurements. **(8 Marks).**

(b)(i). Explain the following bio-signals characteristics and mention one example of each signal.

(I). Intrinsic Bio-signals (II). Extrinsic Bio-signals

(ii). Explain how Biomagnetic signals differ from and bio-mechanical signals. **(7 Marks).**

(c). (i). Define the following popular types of bio signals.

(I). Electro Encephalo Graphy, (EEG). (II). Electro Cardio Graphy, (ECG).

(ii). State the meaning measurements electrodes and how they are used. **(5 Marks).**

QUESTION THREE.

(a)(i). Explain the phenomenon of Thermometry in medical applications.

(ii). State any two disadvantages of using thermocouple based thermometers in clinical measurements.

(iii). With the aid of a diagram, explain the construction and operation of a mercury glassed thermometer. **(13 Marks).**

(b)(i). Define an infrared thermometer, hence explain how it used to measure temperature.

(ii). Mention any two advantages of using infra-red thermometers in hospitals. **(7 Marks).**

QUESTION FOUR.

(a) (i). Define instrumentation system and explain and explain how it assists in medical measurement systems.

(ii). Draw a block diagram of an instrumentation system and explain the functions of the last two elements of a instrumentation block diagram. **(10 Marks).**

(b)(i). Define a solar cell, hence explain why it is categorized as an active device.

(ii). Mention any two examples of passive transducers. **(4 Marks).**

(c). (i). Identify the circuit of Fig Q 4 and explain its operation.

(ii). Name one industrial application of the circuit. **(6 Marks).**

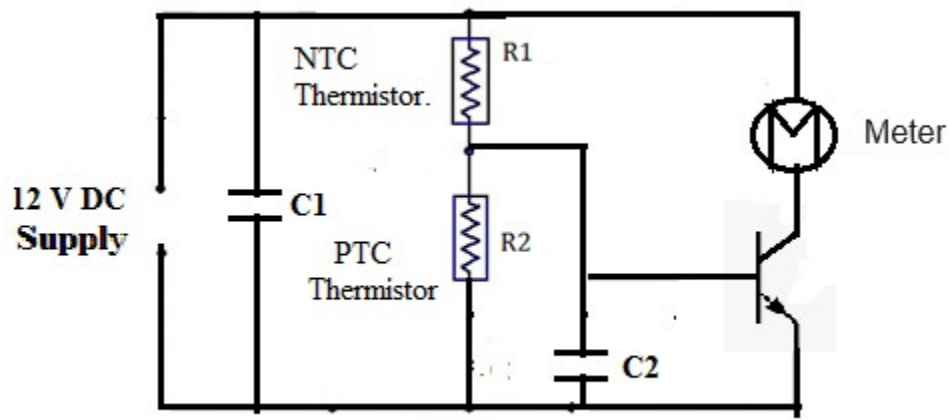


FIG Q 4

QUESTION FIVE.

(a)(i). Define a measurement meter and differentiate between analogue and digital meters.

(ii) State any two advantages of using digital meters over analogue meters in bio signal measurements.

(iii). Explain the meaning of the following terms as used with measurement meters.

(I). Repeatability.

(II). Sensitivity.

(8 Marks).

(b)(i). State any two advantages of using a recording over indicating meters in measurements.

(ii). Draw and explain the construction and operation of a helical bimetallic thermometer.

(iii). State any two advantages and two applications of bimetallic helical thermometers. **(12 Marks).**