



# **TECHNICAL UNIVERSITY OF MOMBASA**

*Faculty of Engineering and Technology*  
**DEPARTMENT OF MEDICAL ENGINEERING**

DIPLOMA IN INSTRUMENTATION AND CONTROL ENGINEERING  
(DICE 5 ) Y3 S1

**ECI 2203**  
**MEASUREMENT TECHNOLOGY II**

SPECIAL/SUPPLEMENTARY EXAMINATIONS

**SERIES:** JULY, 2014

**TIME:** 2 HOURS

**INSTRUCTIONS TO CANDIDATES:**

- This paper consists **FIVE** questions
  - Attempt question **ONE** and any other **TWO** questions
- This paper consists of **3 PRINTED** pages

### QUESTION ONE (COMPULSORY)

- (a) Resistance thermometers and thermistors are both temperature measuring devices that convert measured temperature into a resistance change. What are the main differences between these TWO types of devices in respect of:
- (i) Materials used in their construction (give examples)
  - (ii) Their cost
  - (iii) Their operating characteristics (sketch the response) for both cases (12 marks)
- (b) Using a well labeled sketch, explain both the constructional and working principle of an electromagnetic flow meter. (10 marks)
- (c) A venture tube of minimum cross sectional area  $0.25 \text{ m}^2$  measures the flow rate of water in a pipeline of cross sectional area  $0.65 \text{ m}^2$ . The velocity of flow through the venture meter is  $12.0 \text{ ms}^{-1}$ .
- (i) Determine the volume flow rate through the pipe.
  - (ii) Determine the velocity of flow through the pipe (4 marks)

State **TWO** advantages and **TWO** disadvantages of venture tube over orifice plate. (4 marks)

### QUESTION TWO

- (a) Name **THREE** kinds of temperature-measuring devices that work on the principle of thermal expansion. (2 marks)
- (b) With an aid of well labeled diagrams, explain how each device in 2(a) above works and what its typical characteristics are. (18 marks)

### QUESTION THREE

- (a) Explain the meaning of the following terms as they apply in flow measurement.

Static pressure

Velocity pressure

Stagnation pressure (6 marks)

- (b) Using a suitable sketch, explain both the constructional features and the working principle of a pitot static tube flow meter. (10 marks)
- (c) Discuss any **TWO** limitations of a pitot static tube. (4 marks)

## QUESTION FOUR

(a) (i) Explain why thermal lag might be less for a thermocouple than for a resistance thermometer

(ii) A relay coil takes a current of 0.12 A at 20°C when connected to a 60 V d.c supply.

(I) Calculate the rise in temperature if the relay now takes a current of 0.1 A at the same supply, given that resistivity ( $\alpha$ ) of relay coil is 0.0043 per °C at 0°C

(II) Convert the calculated value in I from Celsius to Fahrenheit. **(8 marks)**

(b) An electromagnetic flow meter is used to measure the average flow rate of an effluent in a pipe of 50 mm diameter. The velocity profile is symmetrical and can be assumed uniform. The flux density in the liquid has a peak value of 0.1 Wb/m<sup>2</sup>, the output from the flow meter electrodes is taken to an amplifier of gain 1000 and impedance between electrodes is 250 k $\Omega$ .

(i) Determine the effluent average velocity when the peak voltage at the amplifier output is 0.2 V

(ii) Given that the effluent conductivity decreases by 20% with the same flow rate, determine the percentage change in reading at the amplifier output. **(8 marks)**

(c) State **TWO** advantages and **TWO** limitations of electromagnetic flow meters. **(4 marks)**

## QUESTION FIVE

(a) Define the following terms:

(i) Absolute zero

(ii) Specific heat

**(2 marks)**

(b) State any **THREE** general characteristics of differential pressure flow meters that should be borne in mind when deciding on the most suitable meter for a given application **(3 marks)**

(c) Using well labeled diagrams, explain both the constructional features and the working principles of the following devices.

(i) Venturi meter

(ii) Optical pyrometer.

**(15 marks)**

