



# THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

## *Faculty of Engineering and Technology*

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

### **DIPLOMA IN TECHNOLOGY** Electronics and Automation Engineering

**EEC 2201**

### **MEASUREMENT TECHNOLOGY II**

SEMESTER IV EXAMINATION

**SERIES:** FEBRUARY 2011 SERIES

**TIME:** 2 HOURS

#### **Instructions to Candidates:**

1. You are required to have the following for this examination;
  - Answer booklet
  - A non-programmable calculator
2. This paper consists of FIVE Questions. Answer Question **ONE (COMPULSORY)** and any other **TWO** Questions.

**(COMPULSORY)**

**Question ONE**

- a) i) Explain briefly, the principle of operation of electromagnetic flow meters.  
ii) List any TWO advantages and TWO disadvantages of the electromagnetic flow meters.  
iii) State any TWO advantages of ultrasonic flow meters. (8 marks)
- b) i) State the principle of conservation of energy.  
ii) Write down the Bernoulli's equation and define each term.  
iii) What is the significance of Reynold's number in flow measurement. (6 marks)
- c) With reference to thermocouples, explain the following:  
i) Seebeck effect  
ii) Peltier effect  
iii) Thomson effect  
iv) Thermopile (8 marks)
- d) A copper-constantan thermocouple was found to have a linear calibration between  $0^{\circ}\text{C}$  to  $400^{\circ}\text{C}$  with e.m.f at maximum temperature (reference junction temperature  $0^{\circ}\text{C}$ ) equal to 20.68 mV.  
i) Determine the correction which must be made to the indicated e.m.f. if the cold junction temperature is  $25^{\circ}\text{C}$ .  
ii) If the indicated e.m.f. is 8.92mV in the thermocouple circuit, determine the temperature of the hot junction. (8 marks)

**(ANSWER ANY OTHER TWO QUESTIONS)**

**Question TWO**

- a) i) Distinguish between Quantity and Rate of flow measurement devices.  
ii) Explain the principle of positive displacement flow measurement. (6 marks)
- b) Explain the construction and principle of operation of the following positive displacement flow meters.  
i) Nutating disc meter.  
ii) Lobed-impeller meter. (14marks)

### **Question THREE**

- a) State the principle of operation of the following rate of flow meters giving an example of each.
- i) Variable Head meters
  - ii) Variable Area meters (6 marks)
- b) A nozzle is fitted in a horizontal pipe of diameter 15cm, carrying a gas of density  $1.15\text{kg/m}^3$ , for the purpose of flow measurement. The differential pressure head indicated by a u-tube manometer containing oil of specific gravity 0.8 is 10cm. If the co-efficient of discharge and the diameter of the nozzle are 0.8 and 5cm respectively, determine the flow of gas through the nozzle flow meter. (8 marks)
- c) With the aid of a sketch, explain the construction and operation of a rotameter. (6 marks)

### **Question FOUR**

- a) i) With the aid of a schematic diagram, explain the principle of operation of a disappearing filament optical pyrometer.
- ii) The power radiated from a hot piece of metal was measured by the radiation pyrometer and the temperature was determined as  $820^{\circ}\text{C}$  assuming a surface of emissivity of 0.75. Later, it was found that the accurate value of emissivity was 0.69. Find the error in the temperature determination. (14marks)
- b) Describe with the aid of a sketch how a direct reading wheatstone bridge may be used with a resistance thermometer to measure temperature, incorporating THREE lead method of compensation. (6 marks)

### **Question FIVE**

- a) i) State any TWO merits and TWO demerits of liquid in glass thermometers.
- ii) Describe the principle of operation of Bimetallic thermometers.
- iii) Express a temperature of  $200^{\circ}\text{F}$  in degrees Celsius and then degrees Kelvin. (11marks)
- b) i) With the aid of a sketch, explain the construction and operation of filled-system thermometer.
- ii) A gas in a fixed volume has a pressure of 30 psi at a temperature of  $20^{\circ}\text{C}$ . What is the temperature in  $^{\circ}\text{C}$  if the pressure in the detector has increased to 35 psi. (9marks)