THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

DIPLOMA IN INSTRUMENTATION AND CONTROL ENG

EEC 3 2202: MEASUREMENT TECHNOLOGY II

END OF SEMESTER EXAMINATIONS

SERIES: AUGUST/SEPTEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*

This paper consists of **FIVE** questions

Answer question **ONE (COMPULSORY)** and at least **THREE** other questions

This paper consists of **THREE** printed pages

Question 1 (Compulsory)

a) With regard to thermocouples, explain the following
   i) Seebeck effect
   ii) Peltier effect
   iii) Thomson effect
   iv) Law of intermediate temperature
   v) Law of intermediate metals (10 marks)

b) (i) Distinguish between the following two categories of metals as used in the construction of Thermocouple elements

   (a) Rare (precious) metals
   (b) Base metals

   (ii) A copper-constantan thermocouple was found to have linear calibration between 0°C to 400°C with e.m.f at maximum temperature (reference junction temperature is 0°C) equal to 20.68m.

   (a) Determine the correction which must be made to the indicated e.m.f if the cold junction temperature is 25°C

   (b) If the indicated e.m.f is 8.92mV in the thermocouple circuit, determine the temperature of the hot junction (6 marks)

c)
   (i) With reference to flow measurement methods, distinguish between Quantity flow meters and rate of flow meters.
   (ii) State any TWO factors that determine the choice of method of flow measurement
   (iii) Distinguish with the aid of typical velocity profile, streamline and turbulent flow.
   (iv) State the law of continuity of flow. (9 marks)

d) With the aid of a schematic diagram, explain the construction and operation of a Rotameter (5 marks)

Question 2

a) (i) Define temperature
   (ii) Explain the significance of the International Practical Temperature Scale
   (iii) Express a temperature of 125°C in degrees Fahrenheit and in Kelvin
   (iv) state any TWO merits and demerits of liquid in glass thermometer s (11 marks)

b) (i) With the aid of a sketch, explain how capillary tube error may be compensated for in liquid in metal thermometers
   (ii) Explain the principle of operation of vapour pressure thermometer (9 marks)

Question 3

a) (i) Differentiate between a thermistor and a metal resistance thermometer in relation to Temperature measurement.

(ii) A platinum resistance thermometer has a resistance of 140.5 Ω and 100.0 Ω at 100°C and 0°C respectively. If its resistance becomes 305.3 Ω when it is in contact with a hot gas, determine the temperature of the gas. The temperature coefficient of planimum is $0.0039^{o}C^{-1}$

(iii) State **TWO** advantages and **TWO** disadvantages of platinum when used for the Construction of resistance thermometers

(iv) Describe the 4 – lead compensation method as applied with resistance thermometers (14 marks)

b) With the aid of a schematic diagram, describe the total radiation pyrometer as used for temperature measurement (6 marks)

Question 4

a) Explain the term 'positive-displacement' meter as applied to a flow measuring devices (3 marks)

b) Explain with the aid of schematic diagrams the construction and operation of the following flow meters
   (i) Nutating disc meter
   (ii) Lobed-impeller meter (14 marks)

c) List the THREE main types of volumetric gas flow meters (3 marks)

Question 5

a) (i) Distinguish between Variable Head meters and Variable area meters as applied to rate flow meters

(ii) Give two examples of each of meters described in a)(i). (7 marks)

b) (i) Define Reynold's number and explain its significance in relation to flow measurement.

(ii) A nozzle is fitted in a horizontal pipe of diameter 15 cm, carrying a gas of density $1.15kg/m^3$, for the purpose of flow measurement. The differential pressure head indicated by a U-tube manometer containing oil for specific gravity 0.8 is 10 cm. If the coefficient of discharge and diameter of nozzle are 0.8 and 5cm respectively, determine the flow of gas through the nozzle flow meter. (8 marks)

c) (i) Explain Bernoulli's principle in relation to fluid flow
   (ii) Define the following energies in relation to Bernoullis principle
      (a) Pressure energy
      (b) Kinetic energy
      (c) Potential energy (5 marks0