TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MEDICAL ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN MEDICAL ENGINEERING

EHL2205:MEASUREMENT

END OF SEMESTER EXAMINATION

SERIES:AUGUST2019

TIME: 2HOURS

DATE:6Aug2019

Instructions to Candidates

You should have the following for this examination
-Answer Booklet, examination pass and student ID
This paper consists of five questions.
Attemptany THREE questions.
Do not write on the question paper.

QUESTION ONE

(a) convert 760mmHg into (i) mmH_2O

(ii) bars. **(4 marks)**

(b) Briefly explain the following terms as used in measurements .

(i) transducer

(ii) calibration

(iii) accuracy **(6 marks)**

(c) With the aid of a clearly labelled diagram describe how a pressure gauge can be calibrated using a U-tube manometer. **(10 marks)**

QUESTION TWO

(a) (i) Using block diagram, explain the difference detween open loop and close loop control system.

(ii)The forward path gain of an open loop system is 50. Determine the gain if negative feedback is employed with a feedback gain of 0.1

(iii)Name any three control loop elements and three control loop signals **(14 marks)**

(b) Describe the principle of operation of the following temperature transducers

(i) thermocouple

(ii) thermistors **(6 marks)**

QUESTION THREE

(a) An inclined tube manometer is used where low differential pressures are involved.

Draw a suitable diagram and show that the differential pressure is given by the expression

$\Delta P = \rho gh (\sin\alpha)$. **(11 marks)**

(b) (i) List the three main causes of instrument errors in measurement system.

(ii) Briefly explain the remedies to the errors listed in (b)(i) above. **(9marks)**

QUESTION FOUR

(a) The differential equation describing a mercury in glass thermometer is $4\frac{d\theta o}{dt} + 2\theta o = 2x10 - 3\ \theta i$ where Θo is the height of mercury column in metres and Θi is the input temperature in ^{o}C. Determine,

(i)the time constant,

(ii) sensitivity of the thermometer **(5marks)**

(b) (i) With the aid of a diagram describe the principle of operation of a linear variable differential transformer (LVDT)

(ii) List any three important characteristics or features of an lvdt. **(9marks)**

(c) the resistance of a platinum thermometer is 15Ω at 0^{o}C. Given that the temperature coefficient of platinum is 0.0039. determine the resistance at 75^{o}C. **(6marks).**

QUESTION FIVE

(a)

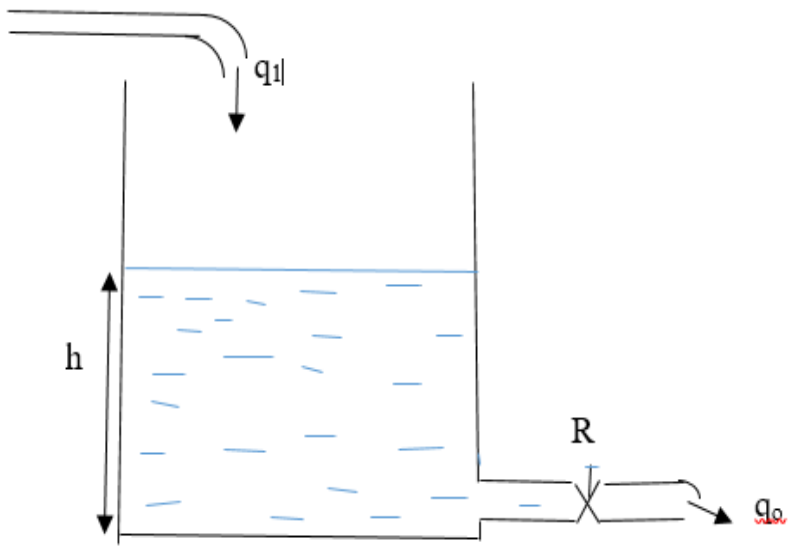

Fig. Q5(a).

The fig Q5(a) is that of a process tank of uniform cross-sectional area A . the input flow rate is denoted by $\mathbf{q_1}$ and output by $\mathbf{q_o}$. The level of the liquid in the tank is h. R is the resistance of the outlet valve. Show that

$q_1 = A\frac{dh}{dt} + Rh$. State any assumptions made. **(10 marks)**

(b) a voltmeter having a sensivity 1000Ω/V reads 50V on its 150V scale when connected across a resistor of unkown value in series with a milliammeter. When the milliameter reads 1A, determine

(i) The apparent resistance of the unknown resistor.

(ii) Actual resistance of the voltmeter

(iii) The effective resistance of the multimeter circuit together with the unknown resistor.

(10marks)