



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:6Apr2019

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 any THREE questions.

Do not write on the question paper.

QUESTION ONE

(a) Define the following terms

(i) transducer

(ii) accuracy

(iii) stability (6 marks)

(b) The differential equation describing a mercury in glass is $4 \frac{d\theta_o}{dt} + 2\theta_o = 2 \times 10^{-3} \theta_i$ where θ_o is the height of mercury column in metres and θ_i is the input temperature in °C. Determine,

- (i) the time constant, (5 marks)
- (ii) sensitivity of the thermometer

(c) (i) List any three important characteristics or features of an lvdt
(ii) With the aid of a diagram describe the principle of operation of a linear variable differential transformer (LVDT) (9marks)

QUESTION TWO)

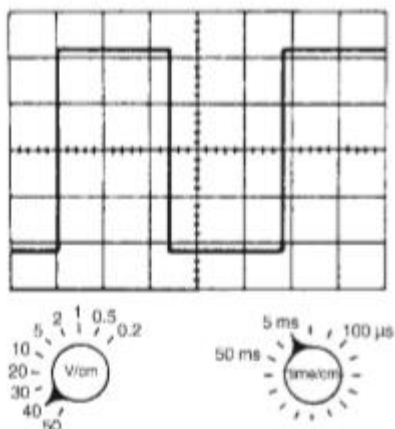
(a) List any five level measuring methods. (5marks)

(b) A U-tube manometer is filled with mercury and an oil of unknown density .Both ends of the manometer are exposed to the atmosphere .Show that the density of the oil is give by

$\rho_{oil} = \frac{H}{h} \rho_{Hg}$ write down any assumption you make. (7 marks)

(c) For the square voltage waveform displayed on a c.r.o. shown in Figure Q5(c), find

- (i) its frequency,
- (ii) its peak-to-peak voltage.



f

figQ5(c) (4 marks)

(d) State any two effects of lack of calibration in measuring systems. (4marks)

QUESTION THREE

(a)

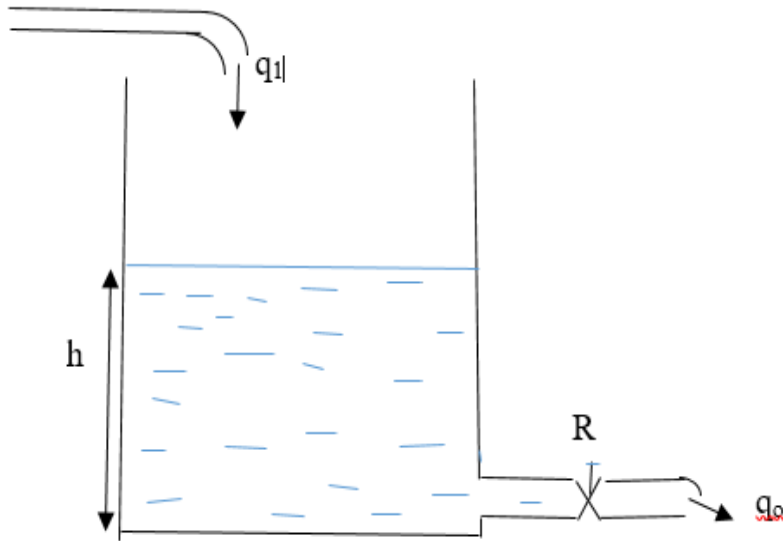


Fig. Q3(a).

Fig Q3(a) is that of a process tank of uniform cross-sectional area **A**. the input is denoted by **q₁** and output by **q_o**. The level of the liquid in the tank is **h**. **R** is the resistance of the outlet valve. Show that

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

(b) A manometer tube is connected to a water pipe under pressure and the level of the liquid is 0.8m above the centre line of the pipe. If the barometric pressure reading is 750mm, calculate the absolute pressure of the water in the pipe.

(10marks)

QUESTION FOUR

(a) (i) Using block diagram, explain the difference between 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

(8marks)

(b) (i) Name any **three** control loop elements and **three** control loop signals

(ii) the resistance of a platinum thermometer is 15Ω at 0°C. Given that the temperature coefficient of platinum is 0.0039. determine the resistance at 75°C.

(12marks).

QUESTION FIVE.

(a) With the aid of labelled diagrams, explain the following categories of pressure measurements. (i) Absolute pressure

(ii) Gauge pressure

(iii) Differential pressure.

(9 marks)

(b) With the aid of a labelled diagram explain the operation of the following methods of liquid level measurements. (i) dipstick
(ii) sight glass **(11marks)**