



TECHNICAL UNIVERSITY OF MOMBASA
**Faculty of Engineering &
Technology**

DEPARTMENT OF MEDICAL ENGINEERING
DIPLOMA IN MEDICAL ENGINEERING (Y2 S2)

EHL 2205: MEASUREMENT

END OF SEMESTER EXAMINATION

SERIES: APRIL 2014

TIME ALLOWED: 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 any other **TWO** questions

Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

- a) A load cell is calibrated in an environment at a temperature of 21°C and has the following deflection/load characteristics:

Load (kg)	0	50	100	150	200
Deflection (mm)	0.0	1.0	2.0	3.0	4.0

When used in an environment at 35°C, its characteristics changes to the following:

Load (kg)	0	50	100	150	200
Deflection (mm)	0.2	1.3	2.4	3.5	4.6

- (i) Plot on the same axis graphs of deflection vs load
- (ii) Determine the sensitivity at 21°C and 35°C
- (iii) Calculate the total zero drift and sensitivity drift at 35°C
- (iv) Determine the zero drift and sensitivity drift

Coefficients (in units of $\mu\text{m}/^\circ\text{C}$ and $(\mu\text{m}/\text{kg})/^\circ\text{C}$) **(20 marks)**

- b) Draw sketches to illustrate the dynamic characteristics of the following:

- (i) Zero order instrument
- (ii) First order instrument
- (iii) Second order instrument

In the case of second order instrument, indicate the effect of different degrees of damping on the time response. **(10 marks)**

Question Two

With an aid of well labeled diagrams, describe both the constructional features and the working principle of the following transducers:

- (i) Pirani gauge
- (ii) Linear variable Differential Transformer (LVDT) **(20 marks)**

Question Three

- a) With an aid of a well labeled diagram, explain both the constructional features and the working principle of an electromagnetic flow meter. **(10 marks)**
- b) Discuss any **THREE** reasons as to why a.c. excitation is preferred to d.c. excitation in electromagnetic flow meters. **(6 marks)**
- c) State any **TWO** advantages and **TWO** disadvantages of electromagnetic flow meters. **(4 marks)**

Question Four

- a) What is the thermometric property of:
- (i) RTD
 - (ii) Thermistor, sketch the response for both devices **(6 marks)**
- b) With the aid of labeled diagrams, explain the principle of operation of the following transducers: **(14 marks)**
- (i) Bourdon tube
 - (ii) Bellows
 - (iii) Diaphragm

Question Five

- a) Define the following terms as used in measurement systems:
- (i) Karman vortex street
 - (ii) Vena contracta
 - (iii) Threshold
 - (iv) Reproducibility **(4 marks)**
- b) Briefly describe the THREE thermocouple junction types available and state the application of each. **(9 marks)**
- c) With the aid of labeled diagrams, explain the principle of operation of an optical pyrometer. **(7 marks)**