FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: DIPLOMA IN ELECTRICAL AND CONTROL ENGINEERING

YEAR/SEM: YEAR 2/SEMESTER 2

COURSE CODE: DEE2204

NAME: ELECTRICAL AND ELECTRONIC INSTRUMENTS II

DATE: 2025-04-23

TIME: 9:00AM-12:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully

2. The time allowed for this examination is STRICTLY three hours

3. Read each question carefully before you attempt and allocate your time equally between all the Sections

4. Write clearly and legibly. Illegible handwriting cannot be marked

5. Number the questions you have attempted

6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks

7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A Answer any two questions

Question 1:

(a) Using a block diagram, explain what a transducer is and its applicatio[...]
industry setup (7 marks)

(b) Explain the difference between;

    (i) accuracy and precision as applied to measuring instruments (4 ma[...]

    (ii) Sensitivity and Tolerance of an instrument (4 marks)

    (iii) Repeatability and Reproducibility of an instrument (4 marks)

(c) Mention three characteristics of good transducers used in industries.

Question 2:

(a) Explain the following speed transducers used for measuring th[...]
speed of a rotating object:

    (i) Optical pickups   (5marks)

    (ii) Magnetic pickups   (5 marks)

(b) A thermocouple produces an e.m.f. in mV according to the te[...]
difference between the sensor tip θ_1 and the gauge head [...]
that $e = \alpha(\theta_1 - \theta_2) + \beta(\theta_1^2 - \theta_2^2)$; $\alpha = 3.5$ x 10^{-2} and $\beta = 8.2$ x 10^{-6}. The g[...]
is at 20^0C. The mV output is 10 mV. Calculate the temperature at th[...]

(c) Describe the operating principle of a float level petrol tank level in[...]
an active instrument   (7marks)

Question 3:

(a) (i) In what ways can the act of measurement cause a disturbance in the system being measured?   (5marks)
(b) Draw the following inputs in electronics measurements
   (i)   A Ramp input
   (ii)   A steady input
   (iii)   Random input
   (iv)   Impulse input
   (v)   Sinusoidal input (10marks)
 (c) Instruments are normally calibrated and their characteristics defined for particular standard ambient conditions. Explain the procedures that are normally taken to avoid measurement errors when using instruments that are subjected to changing ambient conditions?
                  (10 marks)

Question 4:

(a) Describe the basic construction of a resistance type temperature state the reason why it is unaffected by the temperature of the gauge

(b) A platinum resistance thermometer has a resistance of 100Ω at 0 value of α is 0.00385. In operation the resistance is 105Ω. Ca temperature?   (3

(c) Describe the operation of a thermocouple as a temperature trans explain 5 reasons why glass thermometers are not used much the Industries (10marks)

(d) Distinguish between primary and secondary transducers (5 marks)

Section B Answer any two questions

Question 1:

(i) Distinguish between *Range* and *relative accuracy* in measurements? (4

(ii) How can accuracy in instruments be improved? (6 marks)

The following measurement sets A, B, and C were obtained in an industry

below;

398 420 394 416 404 408 400 420 396 413 430   (Measurement set A)

409 406 402 407 405 404 407 404 407 407 408   (Measurement set B)

409 406 402 407 405 404 407 404 407 407 408 406 410 406 405 408

406 409 406 405 409 406 407   (Measurement set C)

Calculate σ and V for measurement sets A, B and C above.   (1

Question 2:

(a) A thermocouple produces an e.m.f. in mV according to the te
difference between the sensor tip θ_1 and the gauge head
that $e = \alpha(\theta_1 - \theta_2) + \beta(\theta_1^2 - \theta_2^2)$. Given $\alpha = 3.5 \times 10^{-2}$ and $\beta = 8$
Determine the mV output when the tip is at 220°C and the gaug
20°C?   (5 marks)

(b) Explain what tachometers mean as applied to the measurement of
speed for rotating objects? (6marks)

(c) Explain how the following pressure transducers work:

   (i) Bourdon tube   (7n

   (ii) Bellows and capsules   (7

Question 3:

  (a) Â Mention five different types of Ammeters and voltmeters used in electrical measurements and
instrumentation?Â Â
Â (10 marks)Â Â Â

(b) **(i)** There are two types of moving coil instruments: permanent-magnet type and dynamometer type, Explain the difference between the two? (6 marks)

(ii) The spring constant of a 10-A dynamometer wattmeter is 10.5×10^{-6} N-m per radian. The variation of inductance with angular position of moving system is practically linear over the operating range, the rate of change being 0.078 mH per radian. If the full-scale deflection of the instrument is 83 degrees, calculate the current required in the voltage coil at full scale on d.c. circuit. (6 marks)

(c) A transformer has 1200 turns on the primary coil and 200 on the secondary. If the input is 110V a.c. what is the ideal output? (3marks)

Question 4:

(a) What is the difference between systematic and random errors? (4marks)

(b) Give four methods of minimizing systematic errors in measurements (8marks)

(c) What causes random errors, and how can they be minimized in measurements (10 marks)

(d) Why is it important to take multiple measurements when dealing with random errors? (3marks)