



Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

ECI 2204 INSTRUMENTATION

SPECIAL/SUPPLEMENTARY EXAMINATION

**SERIES: SEPTEMBER 2018****TIME: 2 HOURS****DATE: SEPTEMBER 2018****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 **Question ONE** and **ANY other TWO** questions.**Do not write on the question paper****Question ONE**

- (a) Describe the principle of operation of the magnetic field sensor citing a typical applications. (6 marks)
- (b) A pressure transducer and a thermocouple have the following specifications:

	<u>Input Range</u>	<u>Output Range</u>
Pressure transducer	$0 - 10^4 Pa$	$4 - 20mA$
Thermocouple	$100 - 250^{\circ}C$	$4 - 10mA$

Using appropriate sketches and the data above explain for each transducer the

- (i) Span                      (ii) Linearity                      (iii) Sensitivity                      (14 marks)

**Question TWO**

- (a) (i) Distinguish between systematic and random errors
- (ii) Explain any **THREE** sources of systematic errors
- (iii) How are random errors taken care of in measurement systems? (7 marks)
- (b) Describe the term calibration and explain the procedure of carrying it out. (4 marks)

- (c) The voltage across a resistance  $R_5$  in the circuit of Fig. Qu.(2c) is to be measured by a voltmeter connected across it.
- (i) If the voltmeter has an internal resistance ( $R_m$ ) of  $4750\Omega$  determine the measurement error.
- (ii) Calculate the voltmeter internal resistance needed to reduce the measurement error to 1%.
- (9 marks)

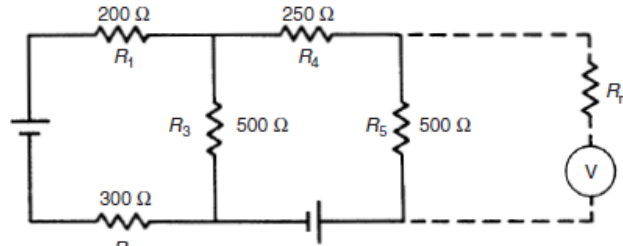


Fig. Qu.(2c)

### Question THREE

- (a) Using appropriate sketches define the following terms with reference to instrumentation systems:
- (i) Linearity                      (ii) Hysteresis                      (iii) Resolution                      (6 marks)
- (b) Explain any THREE ways to reduce systematic errors in instruments.                      (3 marks)
- (c) The FOUR arms of a Maxwell's bridge are arranged as follows: AB and BC are non-reactive resistances of  $100\Omega$  each. DA is a standard variable reactance  $L$  of resistance  $32.7\Omega$  and CD comprises a standard variable resistance  $R$  in series with a coil of unknown impedance. Derive the balance condition and determine the resistance and inductance of the unknown inductor.                      (8 marks)
- (d) Discuss THREE primary roles of gas sensors in today's industrial setting.                      (6 marks)

### Question FOUR

- (a) Define the term calibration and explain the procedure of carrying a calibration exercise.                      (4 marks)
- (b) Describe one way in which a good measurement technician can substantially reduce errors due to environmental changes.                      (3 marks)
- (c) Describe the following distinct uses of analogue measurements:
- (i) Indicate only    (ii) Control                      (iii) Safety                      (iv) Environmental                      (8 marks)
- (d) Using an appropriate sketch describe the principle of operation of a magnetic field Hall effect sensor                      (5 marks)

### Question FIVE

- (a) Using appropriate examples describe THREE ways in which instrumental errors occur.                      (10 marks)
- (b) The following readings were obtained in respect of measurement of a capacitor. Determine:
- (i) The arithmetic mean                      (ii) The standard deviation of the readings
- (iii) The probable error of the mean value
- 1.003, 0.988, 1.001, 1.009, 1.005, 0.996, 0.991, 0.997, 1.008, 0.994  $\mu F$                       (10 marks)