



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017**

COURSE : INSTRUMENTATION AND MEASUREMENT
COURSE CODE : BEH10102
PROGRAMME : BEJ
EXAMINATION DATE : DECEMBER 2016 / JANUARY 2017
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER ALL QUESTIONS

TERBUKA

THIS PAPER CONSISTS OF FOUR (4) PAGES

- Q1** (a) Describe “measurement process” with necessary block diagram. (4 marks)
- (b) Define the following terms with necessary equations:
- (i) Absolute error (1.5 marks)
 - (ii) Relative error (1.5 marks)
 - (iii) Accuracy (1.5 marks)
- (c) (i) Define “sensitivity” of an instrument (1 mark)
- (ii) Define “sensitivity of a voltmeter”. (2 marks)
- (iii) Discuss the “sensitivity” level of a perfect or ideal voltmeter. [hint: note the value of internal resistance of a perfect or ideal voltmeter] (2 marks)
- (d) A voltmeter having a sensitivity of $1 \text{ k}\Omega/\text{V}$ is connected across an unknown resistance in series with a milliammeter reading 30 V on 150 V scale. When the milliammeter reads 600 mA, calculate the followings:
- (i) Apparent resistance of the unknown resistance (2 marks)
 - (ii) Actual resistance of the unknown resistance (2.5 marks)
 - (iii) Error due to loading effect of the voltmeter (2 marks)
- Q2** (a) Explain clearly the difference between absolute pressure and gauge pressure. (4 marks)
- (b) Produce a description on the operation of a pressure sensor based on Bourdon tube. (10 marks)
- (c) A car driver filled his tyres to the specified 32 psig early in the morning at Death Valley, Eastern California which is at 282 feet below sea level. He then drove his car to Leadville, Colorado which is at 10,152 feet above sea level and spent the night there. The next morning, he measured the pressure of his tires and he also made a physical examinations of the tyres as well. Investigate the driver observations when he made the pressure measurements and physical examinations. Assume that the tyres did not suffer any air leaks during the journey. (6 marks)

TERBUKA

- Q3** (a) Define the terms *stress* and *strain*. (4 marks)
- (b) Construct a technique that can be implemented in order to compensate the temperature effect in the measurement of strain. (10 marks)
- (c) A round aluminum bar, 6.2 cm in diameter and 40 cm in length, is subjected to a tensile force of 5390 kg, where the Young's modulus $E = 6.89 \times 10^{10} \text{ kg/m}^2$. Determine:
- (i) the stress of the beam (2 marks)
 - (ii) the strain of the beam (2 marks)
 - (iii) the elongation, ΔL , in meters. (2 marks)

- Q4** (a) What are the common sources of error associated with measurements with a Wheatstone Bridge? (3 marks)
- (b) (i) State the **basic difference** between Kelvin Bridge and Kelvin Double Bridge (with relevant diagram and labelling). (6 marks)
- (ii) Discuss the advantage of using Kelvin Double Bridge over Kelvin Bridge. (2 marks)
- (c) If in Fig. **Q3** the ratio of R_a to R_b is 1000, R_1 is 5Ω and $R_1 = 0.5R_2$. Determine the value of R_x . (4 marks)
- (d) (i) State the "balance conditions" for an AC bridge (with appropriate diagram and labelling). (3 marks)
- (ii) How does the "balance conditions" of an AC bridge differs from that of a DC bridge? (2 marks)

TERBUKA

- Q5** (a) Explain clearly the basic working principles of an incremental encoder and an absolute encoder. (16 marks)
- (b) Design a measurement system where an incremental encoder can be used to determine the distance travelled by a wheeled mobile robot. (4 marks)

-END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER/SESSION	: SEM I / 2016/2017	PROGRAMME	: 1 BEJ
COURSE	: INSTRUMENTATION AND MEASUREMENT	COURSE CODE	: BEH10102

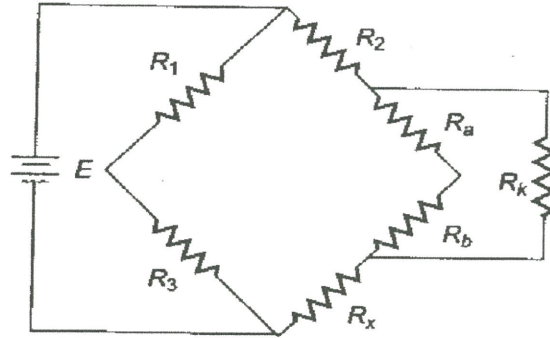


Figure Q3

TERBUKA