



**KOLEJ YAYASAN PELAJARAN JOHOR
FINAL EXAMINATION**

COURSE NAME : INSTRUMENTATION
COURSE CODE : DKE 1033
EXAMINATION : OCTOBER 2019
DURATION : 2 HOURS 30 MINUTES

INSTRUCTION TO CANDIDATES

1. This examination paper consists of **FIVE (5)** questions. Answer **ALL** questions in the answer booklet provided.
Kertas soalan ini mengandungi LIMA (5) soalan. Jawab SEMUA soalan di dalam buku jawapan yang disediakan.
2. Candidates are not allowed to bring any material to examination room except with the permission from the invigilator.
Calon tidak dibenarkan membawa sebarang bahan/nota ke dalam bilik peperiksaan tanpa arahan/kebenaran daripada pengawas peperiksaan.
3. Please check to make sure that this examination pack consist of:
Pastikan kertas soalan peperiksaan ini mengandungi:
 - i. Question Paper/
Kertas soalan
 - ii. Answer Booklet/
Buku jawapan

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*This examination paper consists of **8** printed pages including front page*



This paper contains of **FIVE(5)** questions. Answer **ALL** questions in the Answer Booklet.

*Kertas soalan ini mengandungi **LIMA (5)** soalan. Jawab **SEMUA** soalan di dalam buku jawapan yang disediakan.*

QUESTION 1 / SOALAN 1

- a. Systematic error is one of the types that frequently occur in any measurement. Explain briefly **two (2)** types of errors that are categorized as systematic error.

*Ralat sistematik merupakan salah satu jenis ralat yang sering berlaku di dalam sesuatu pengukuran. Terangkan dengan ringkas **dua (2)** jenis ralat yang dikategorikan sebagai ralat sistematik.*

(3 marks/ markah)

- b. Refer to Table Q1 (b), calculate:
- the average value of the readings.
 - the standard deviation.
 - the precision for all the readings.
 - the worst precision from all the readings.

Merujuk pada Jadual Q1 (b), kirakan :

- nilai purata bacaan.*
- sisihan piawaian.*
- kepersisan semua bacaan.*
- kepersisan terburuk dari semua bacaan.*

Data/ Data	1	2	3	4	5
Readings/ Bacaan	4.5	4.7	5.0	5.2	4.6

Table Q1 (b) / Jadual Q1 (b)

(17 marks/ markah)

QUESTION 2 / SOALAN 2

- a. A 1 mA full scale deflection current meter movement is used in an ohmmeter circuit. The meter movement has an internal resistance, $R_m = 100 \Omega$ and a 3 V battery is used in the circuit. Determine:
- the ohmmeter basic circuit.
 - the value of the variable resistance, R_z .
 - the value of R_x at 20%, 50% and 70% full-scale reflection.

Gerakan meter arus pesongan skala penuh 1 mA digunakan dalam litar meter ohm. Gerakan meter tersebut mempunyai rintangan dalam, $R_m = 100 \Omega$ dan sebuah bateri 3 V digunakan dalam litar tersebut. Tentukan :

- litar asas meter ohm.*
- nilai rintangan bolehubah, R_z .*
- nilai R_x pada 20%, 50% dan 70% pesongan skala penuh.*

(8 marks/ markah)

- b. Figure Q2 (b) shows a half-wave rectifier type AC meter with a range of 50 V. The diodes have a forward resistance of 100Ω while the parameters of the d'Arsonval movement are $50 \mu\text{A}$, 200Ω . It is required that $I_{sh} = I_m$.
- Calculate the shunt resistor R_{sh} .
 - Calculate the multiplier resistor R_s .
 - Calculate the DC sensitivity of the meter.
 - Calculate the AC sensitivity of the meter.

Gambar rajah Q2 (b) menunjukkan meter AU jenis penerus separuh-gelombang ber julat 50 V. Diod mempunyai rintangan ke depan 100Ω sementara parameter gerakan d'Arsonval ialah $50 \mu\text{A}$, 200Ω . Dikehendaki supaya $I_{sh} = I_m$.

- Kirakan rintangan pirau R_{sh} .*
- Kirakan rintangan pendarab R_s .*
- Kirakan kepekaan AT meter.*
- Kirakan kepekaan AU meter.*

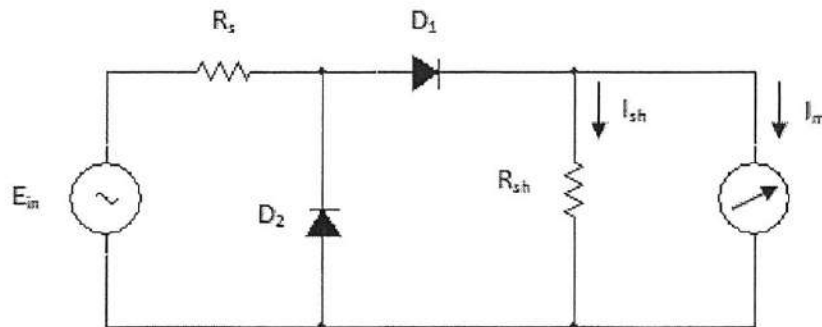


Figure Q2 (b) / Gambar rajah Q2 (b)

(12 marks/ markah)

QUESTION 3 / SOALAN 3

- a. Briefly explain **three (3)** differences between a digital instrument and a digital display instrument.

*Terangkan dengan ringkas **tiga (3)** perbezaan di antara alatan digital dan alatan paparan digital.*

(6 marks/ markah)

- b. A digital multimeter with $3\frac{1}{2}$ digit display and accuracy $\pm (1\% + 10d)$, was used to measure the current in a circuit. Calculate the error and percentage error when measuring 25 A current.

Satu meter pelbagai digit dengan paparan $3\frac{1}{2}$ digit dan kejituan $\pm (1\% + 10d)$, telah digunakan untuk mengukur arus di dalam satu litar. Kirakan ralat dan peratus ralat ketika mengukur arus 25 A.

(6 marks/ markah)

- c. A digital voltmeter as shown in Figure Q3 (c) utilizes a voltage-to-frequency converter as its analogue-to-digital converter. The relationship between the input V_i and the output frequency f is given as:

$$V_i = \frac{f}{100}$$

If 130 pulses are sent to the AND gate in 0.5 seconds, calculate the amplitude of the input voltage V_i .

Sebuah meter volt digit seperti dalam Rajah Q3 (c) menggunakan penukar voltan-ke-frekuensi sebagai penukar analog-ke-digit. Hubungan antara V_i dan frekuensi keluaran f diberikan sebagai:

$$V_i = \frac{f}{100}$$

Jika 130 denyutan dihantar ke get DAN dalam masa 0.5 saat, kirakan amplitud voltan masukan V_i .

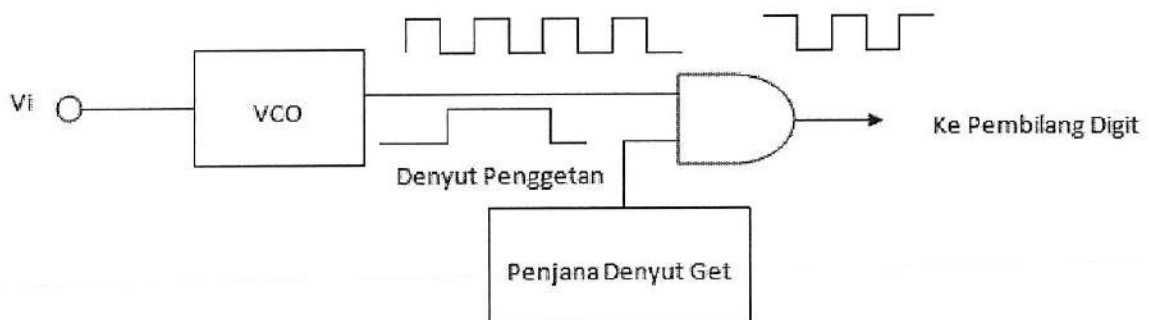


Figure Q3 (c) / Rajah Q3 (c)

(8 marks/ markah)

QUESTION 4 / SOALAN 4

- a. Prepare **three (3)** main factors to be considered in choosing a suitable transducer for an instrumentation system.

*Sediakan **tiga (3)** faktor utama yang perlu dipertimbangkan ketika memilih transduser yang sesuai dalam sistem pengalatan.*

(3 marks/ markah)

- b. A strain gauge with gauge factor 10 and unstrained resistance 100Ω is attached to a steel beam with Young's modulus $E = 2.0 \times 10^6 \text{ N/m}^2$. The beam changes in length from 100 mm to 100.4 mm.
- Calculate the strain G experienced by the beam.
 - Calculate the resistance of the gauge after the strain has been applied.
 - State the type of stress applied to the beam.
 - Calculate the magnitude of the stress.

Sebuah tolok terikan dengan faktor tolok 10 dan rintangan tak terterik 100Ω dilekatkan pada alur keluli dengan modulus Young $E = 2.0 \times 10^6 \text{ N/m}^2$. Alur tersebut berubah panjang dari 100 mm ke 100.4 mm.

- Kirakan terikan G yang dialami oleh alur tersebut.*
- Kirakan rintangan tolok setelah terikan dikenakan.*
- Nyatakan jenis tegasan yang dikenakan pada alur tersebut.*
- Kirakan jumlah magnitud bagi tegasan.*

(17 marks/ markah)

QUESTION 5 / SOALAN 5

- a. Determine **four (4)** characteristics of the operational amplifier.

Tentukan empat (4) ciri penguat kendalian.

(3 marks/ markah)

- b. The Wheatstone bridge in Figure Q5 (b) is used as quarter-bridge where R_4 is connected to a strain gauge. Given that $R_1 = R_2 = R_3 = R$ where R is the initial resistance of the strain gauge. The strain gauge with gauge factor $K = 2.0$ and initial resistance 350Ω is used. The voltage supply 10 V . The gauge experiences a strain of $1450 \mu\text{m/m}$.

- i. Show that the output of the bridge is

$$V_o = \frac{\Delta R}{4R} E$$

- ii. Find the change in resistance of the strain gauge, ΔR .
iii. Calculate the output voltage.

Titi Wheatstone dalam gambar rajah Q5 (b) digunakan sebagai titi suku di mana R_4 disambungkan kepada tolok terikan. Diberi bahawa $R_1 = R_2 = R_3 = R$ dimana R ialah rintangan awal tolok terikan. Tolok terikan dengan faktor $K = 2.0$ dan rintangan awal 350Ω digunakan. Voltan bekalan ialah 10 V . Tolok tersebut mengalami terikan $1450 \mu\text{m/m}$.

- i. Tunjukkan bahawa keluaran titi tersebut ialah

$$V_o = \frac{\Delta R}{4R} E$$

- ii. Dapatkan perubahan rintangan tolok terikan, ΔR .
iii. Kirakan voltan keluaran.

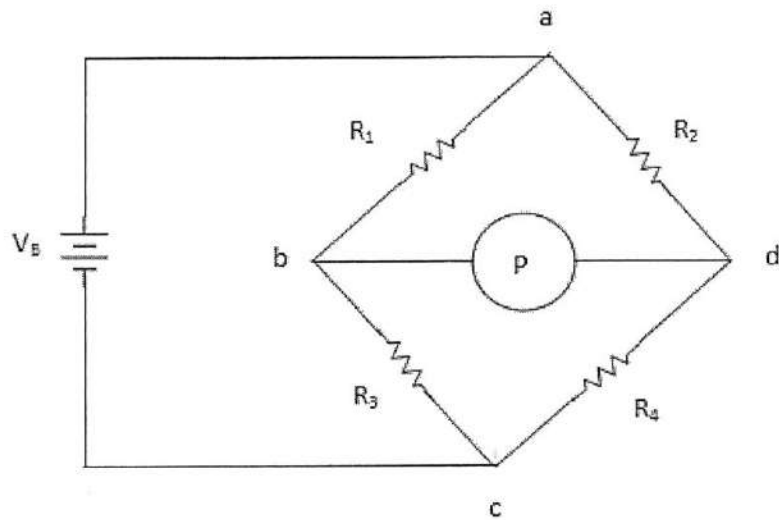


Figure Q5 (b) / Gambar rajah Q5 (b)

(14 marks/ markah)

- c. List down **three (3)** advantages IEEE488 compared to RS232.

Senaraikan **tiga (3)** kebaikan IEEE488 berbanding dengan RS232.

(3 marks/ markah)

[100 MARKS / 100 MARKAH]

END OF QUESTION PAPER / KERTAS SOALAN TAMAT

