



**KOLEJ YAYASAN PELAJARAN JOHOR
ONLINE FINAL EXAMINATION**

COURSE NAME : INSTRUMENTATION
COURSE CODE : DKE 1033
EXAMINATION : DECEMBER 2021
DURATION : 2 HOURS 30 MINUTES

**INSTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON**

1. This examination paper consists of **ONE (1)** part. PART A (100 Markah)
*Kertas soalan ini mengandungi **SATU (1)** bahagian:* *BAHAGIAN A (100 Markah)*
2. Answer ALL questions in the answer sheet which is A4 size paper (or other paper with the consent of the relevant lecturer). /
Jawab SEMUA soalan di dalam kertas jawapan iaitu kertas bersaiz A4 (atau lain-lain kertas dengan persetujuan pensyarah berkaitan).
3. Write your details as follows in the upper left corner for each answer sheet: /
Tulis butiran anda sepertimana berikut di penjuru atas kiri bagi setiap kertas jawapan:
 - i. Student Full Name / *Nama Penuh Pelajar*
 - ii. Identification Card (I/C) No. / *No. Kad Pengenalan*
 - iii. Class Section / *Seksyen Kelas*
 - iv. Course Code / *Kod Kursus*
 - v. Course Name / *Nama Kursus*
 - vi. Lecturer Name / *Nama Pensyarah*
4. Each answer sheet must have a page number written at the bottom right corner. /
Setiap helai kertas jawapan mesti ditulis nombor muka surat di penjuru bawah kanan.
5. Answers should be **neat and clear in handwritten form.** /
Jawapan hendaklah ditulis tangan, kemas dan jelas.

**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU**

This examination paper consists of 7 printed pages including front page
Kertas soalan ini mengandungi 7 muka surat termasuk kulit hadapan

This part contains of **FIVE (5)** questions. Answer **ALL** questions in the answer sheet.
Kertas soalan ini mengandungi LIMA (5) soalan. Jawab SEMUA soalan di dalam kertas jawapan.

QUESTION 1 / SOALAN 1

- a) Explain **two (2)** suitable times to calibrate the equipment.

Terangkan dua (2) masa yang sesuai bagi menentu-ukur sesuatu peralatan.

(4 marks/ markah)

- b) Systematic error is one of the types that frequently occur in any measurement. Briefly explain **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.

(4 marks/ markah)

- c) Refer to **Table Q1 (c)**, calculate:
- The average value of the readings.
 - The deviation.
 - Algebraic sum of all deviations.
 - The standard deviation.

Merujuk pada Jadual Q1 (c), kirakan:

- Nilai purata bacaan.*
- Sisihan.*
- Hasil tambah aljabar kesemua sisihan.*
- Sisihan piawaian.*

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

Table Q1 (c) / Jadual Q1 (c)

(12 marks/ markah)

QUESTION 2 / SOALAN 2

- a) Briefly explain the operating principle of the d'Arsonval movement with its diagram.

Terangkan dengan ringkas prinsip pengendalian gerakan d'Arsonval berserta gambar rajahnya.

(4 marks/ markah)

- b) 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)

- c) **Figure Q2 (c)** shows a half-wave rectifier type AC meter with a range of 50 V. The diodes have a forward resistance of $100\ \Omega$ while the parameters of the d'Arsonval movement are $50\ \mu\text{A}$, $200\ \Omega$. 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, S_{dc} .

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

- Kirakan rintangan pirau, R_{sh} .
- Kirakan rintangan pendarab, R_s .
- Kirakan kepekaan AT meter, S_{at} .

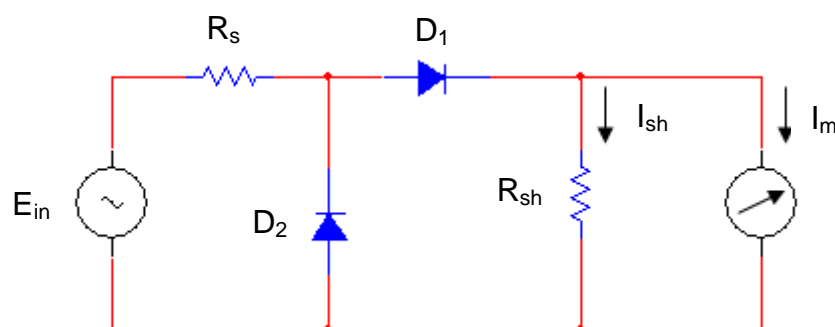


Figure Q2 (c) / Rajah Q2 (c)

(8 marks/ markah)

QUESTION 3 / SOALAN 3

- a) With the aid of diagrams, explain **three (3)** differences between a digital instrument and a digital display instrument.

Dengan bantuan gambar rajah, terangkan **tiga (3)** perbezaan di antara alatan digital dan alatan paparan digital.

(12 marks/ markah)

- b) A digital voltmeter as shown in **Figure Q3 (b)** utilizes a voltage-to-frequency converter as its analogue-to-digital converter. The relationship between the input voltage 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 digital seperti dalam **Rajah Q3 (b)** menggunakan penukar voltan-ke-frekuensi sebagai penukar analog-ke-digital. Hubungan antara voltan masukan 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 .

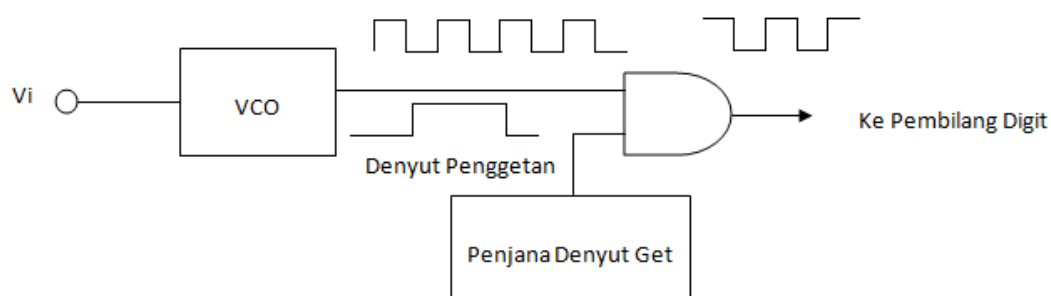


Figure Q3 (b) / Rajah Q3 (b)

(8 marks/ markah)

QUESTION 4 / SOALAN 4

- a) There are eight (8) main factors to be considered when choosing a suitable transducer. Clarify any **three (3)** of these factors.

*Terdapat lapan (8) faktor utama yang perlu dipertimbangkan ketika memilih transduser yang sesuai. Jelaskan mana-mana **tiga (3)** dari faktor tersebut.*

(6 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.
- Give the relationship between the strain and the resistance of the strain gauge.
 - Calculate the strain G experienced by the beam.
 - Calculate the resistance of the gauge after the strain has been applied.
 - Calculate the magnitude of the stress.
 - State **two (2)** main problems in the use of strain gauge.

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.

- Berikan hubungan antara terikan dan rintangan bagi tolok terikan.*
- Kirakan terikan G yang dialami oleh alur tersebut.*
- Kirakan rintangan tolok setelah terikan dikenakan.*
- Kirakan jumlah magnitud bagi tegasan.*
- Nyatakan **dua (2)** masalah utama di dalam penggunaan tolok terikan.*

(14 marks/ markah)

QUESTION 5 / SOALAN 5

- a) State **three (3)** characteristics of the operational amplifier.

*Nyatakan **tiga (3)** 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. Prove 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 **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. Buktikan bahawa keluaran titi tersebut ialah

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

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

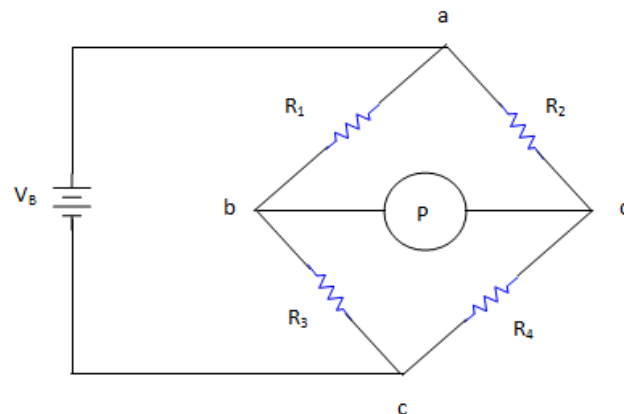


Figure Q5 (b) / Rajah Q5 (b)

(14 marks/ markah)

- c) List down **three (3)** advantages of 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