SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI II : 2024/2025

DJJ20053 : ELECTRICAL TECHNOLOGY

TARIKH : 24 MEI 2025
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **SEPULUH (10)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:
This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab semua soalan.*

QUESTION 1
SOALAN 1

CLO1

(a) Electricity refers to energy derived from charged particles. State the symbol and units for the electrical quantities listed below:
Elektrik merujuk kepada tenaga yang diperoleh daripada zarah bercas. Nyatakan simbol dan unit bagi kuantiti elektrik yang disenaraikan di bawah:

i. Electromotive force
Daya Gerak Elektrik

[2 marks]
[*2 markah*]

ii. Electrical charge
Caj Elektrik

[2 marks]
[*2 markah*]

iii. Current
Arus

[2 marks]
[*2 markah*]

CLO2

(b)

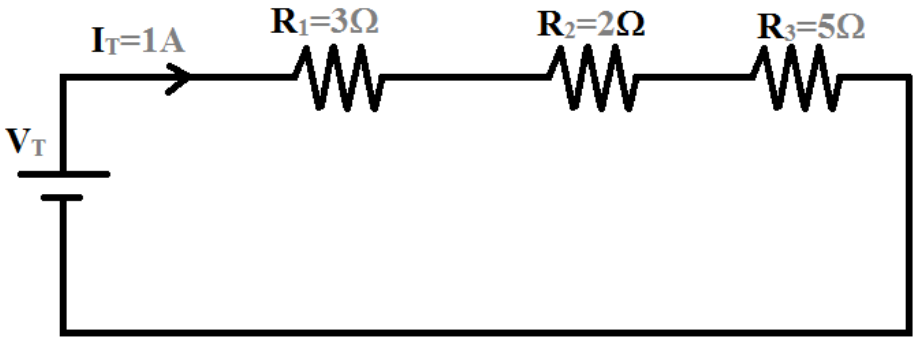

Figure 1(b) / *Rajah 1(b)*

Referring to Figure 1(b), state the value of:
Berdasarkan Rajah 1(b), nyatakan nilai bagi:

i. Total resistance, R_T
Jumlah rintangan, R_T

[2 marks]
[*2 markah*]

ii. Total voltage, V_T
Jumlah Voltan, V_T

[3 marks]
[*3 markah*]

iii. Voltage drops across R_3 by using the voltage divider law
Penurunan voltan pada perintang R_3 menurut hukum pembahagi voltan

[3 marks]
[*3 markah*]

CLO3

(c)

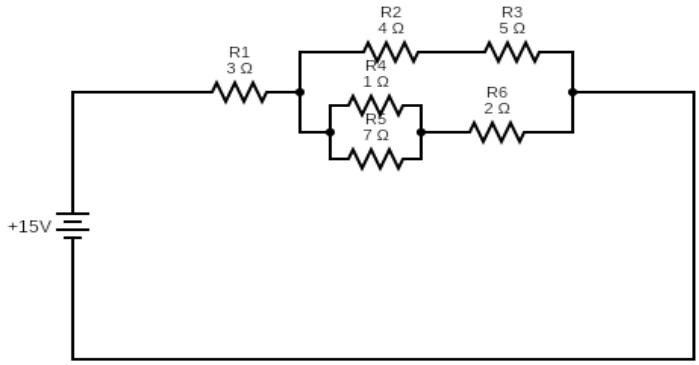

Figure 1(c) / *Rajah 1(c)*

Referring to Figure 1(c), calculate:

Berdasarkan Rajah 1(c), kirakan.

i. Resistance on R_{23}
Rintangan pada R_{23}

[2 marks]

[*2 markah*]

ii. Resistance on R_{45}
Rintangan pada R_{45}

[2 marks]

[*2 markah*]

iii. Resistance on R_{456}
Rintangan pada R_{456}

[2 marks]

[*2 markah*]

iv. Total resistance, R_T
Jumlah rintangan, R_T

[4 marks]

[*4 markah*]

v. Total current, I_T
Jumlah arus, I_T

[1 marks]

[*1 markah*]

QUESTION 2
SOALAN 2

CLO1

(a) An inductor is a spiral coil of wire that generates a magnetic field when current flows through it.
Pearuh ialah gegelung lingkaran dawai yang menghasilkan medan magnet apabila arus mengalir melaluinya.

i. State the symbol and unit of an inductance
Nyatakan simbol dan unit bagi kearuhan

[2 marks]
[*2 markah*]

ii. Describe **TWO (2)** effects of an inductor as an electrical device
*Jelaskan **DUA (2)** kesan peraruh sebagai peralatan elektrik*

[4 marks]
[*4 markah*]

CLO2

(b)

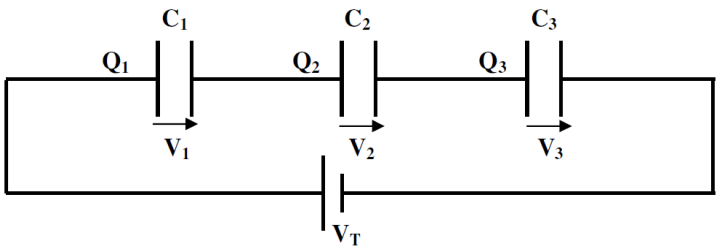

Figure 2(b) / *Rajah 2(b)*

Three capacitors (C_1=3 μF, C_2=2 μF and C_3=1 μF) are connected in series with the supplied voltage of V_T=10V as shown in Figure 2(b), state the value of:
Tiga Kapasitor (C_1=3 μF, C_2=2 μF dan C_3=1 μF) disambung secara siri dengan voltan yang dibekalkan V_T=10V seperti dalam Rajah 2(b), Nyatakan nilai bagi:

i. Total capacitance, C_T
Jumlah kemuatan, C_T

[3 marks]
[*3 markah*]

ii. The value of charge at C_2, Q_2
Nilai cas pada C_2, Q_2

[4 marks]
[*4 markah*]

CLO2 (c) Three impedances in electrical circuit supplies with 415 V, 50 Hz, and connected in a STAR configuration are resistance (R=30 Ω), capacitance (C=30 μF), and inductance (L=0.5 H). Calculate:
Tiga galangan dengan bekalan litar elektrik 415 V, 50 Hz, dan disambungkan dalam konfigurasi STAR dengan rintangan (R=30 Ω), kemuatan (C=30 μF), dan kearuhan (L=0.5 H). Kirakan:

i. Inductance reactance, X_L
Regangan berkearuhan, X_L

[3 marks]
[*3 markah*]

ii. Capacitance reactance, X_C
Regangan berkemuatan, X_C

[3 marks]
[*3 markah*]

iii. Impedance, Z
Galangan, Z

[3 marks]
[*3 markah*]

iv. Phase angle, Θ
Sudut fasa, Θ

[3 marks]
[*3 markah*]

QUESTION 3
SOALAN 3

CLO1

(a) The fundamentals of electromagnetics involve the relationship between current flow in conductors, electromagnetic strength, and magnetic characteristics. List:
Asas elektromagnet melibatkan hubungan antara aliran arus dalam konduktor, kekuatan elektromagnet, dan ciri magnet. Senaraikan:

i. **TWO (2)** types of magnets
DUA (2) *jenis magnet*

[2 marks]
[*2 markah*]

ii. **FOUR (4)** factors that influence electromagnetic strength
EMPAT (4) *faktor yang mempengaruhi kekuatan electromagnet*

[4 marks]
[*4 markah*]

CLO2

(b) Express the value of the flux density in a circular magnetic field with a given radius of 3cm having a flux of 3mWb.
Nyatakan nilai bagi ketumpatan fluks dalam medan magnet sebuah bulatan dengan jejari 3 cm yang mempunyai fluks sebanyak 3mWb.

[8 marks]
[*8 markah*]

CLO2

(c) A coil with 330 turns is wound uniformly on a brass ring core. The core has ring length of 0.03m and a uniform cross-sectional area of $0.002m^2$. If the current through the coil is 0.5 A. Calculate:

Satu gegelung dililit secara seragam sebanyak 330 lilitan pada teras gegelang tembaga. Teras tersebut mempunnyai ukurlilit sebanyak 0.03m dan luas keratan rentas seragam adalah sebanyak $0.002m^2$. Jika arus yang mengalir di dalam gegelung adalah 0.5 A. Kirakan:

i. Diameter of the ring core, d
Diameter teras gegelang, d

[2 marks]
[*2 markah*]

ii. Magnetic field strength, H
Kekuatan medan magnet, H

[2 marks]
[*2 markah*]

iii. Magnetic flux density, B
Ketumpatan medan magnet, B

[3 marks]
[*3 markah*]

iv. Magnetic flux, Φ
Fluks magnet, Φ

[2 marks]
[*2 markah*]

v. Reluctance, S
Engganan medan magnet, S

[2 marks]
[*2 markah*]

QUESTION 4
SOALAN 4

CLO1 (a) Describe briefly **TWO (2)** basic parts of AC motor.
*Terangkan secara ringkas **DUA (2)** bahagian asas motor AC.*

[6 marks]
[*6 markah*]

CLO2 (b) A 6-pole, single phase, 50 Hz induction motor runs at 750 rev/min at full load, state the value of:
Sebuah motor aruhan satu fasa mempunyai 6 kutub, 50 Hz bergerak dengan kelajuan 750 psm pada beban penuh, nyatakan nilai bagi:

i. Synchronous speed, N_S
Kelajuan segerak, N_S.

[2 marks]
[*2 markah*]

ii. Slip, S
Gelinciran, S

[3 marks]
[*3 markah*]

iii. Frequency of the rotor, f_r
Rotor frekuensi, fr

[2 marks]
[*2 markah*]

CLO2

(c) On full load, a 400 kVA transformer with 10000 V/510 V and 50 Hz has a copper loss of 7.5 kW. If the core loss is 2.3 kW and the lagging power factor is 0.91, calculate the efficiency on:
Pada beban penuh, pengubah 400 kVA dengan 10000V/510V dan 50 Hz mempunyai kehilangan kuprum sebanyak 7.5 kW. Jika kehilangan teras ialah 2.3 kW dan faktor kuasa ketinggalan ialah 0.91, hitung kecekapan pada:

i. Full load
Beban penuh

[6 marks]
[*6 markah*]

ii. Half load
Beban separuh

[6 marks]
[*6 markah*]

SOALAN TAMAT

DJJ20053 – ELECTRICAL TECHNOLOGY

FORMULA

INTRODUCTION TO ELECTRICAL CIRCUITS

$$R = \frac{\rho l}{A} \qquad C = \frac{Q}{V}$$
$$V = IR \qquad P = IV$$
$$E = Pt$$

SERIES

$$V_T = V_1 + V_2 + \cdots + V_n$$
$$I_T = I_1 = I_2 = \cdots = I_n$$
$$R_T = R_1 + R_2 + \cdots + R_n$$
$$L_T = L_1 + L_2 + \cdots + L_n$$
$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots + \frac{1}{C_n}$$
$$V_X = \frac{R_X}{R_T} V_T$$

PARALLEL

$$V_T = V_1 = V_2 = \cdots = V_n$$
$$I_T = I_1 + I_2 + \cdots + I_n$$
$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$$
$$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \cdots + \frac{1}{L_n}$$
$$C_T = C_1 + C_2 + \cdots + C_n$$
$$I_X = \frac{R_T}{R_X} I_T$$

ALTERNATING CURRENT CIRCUIT

RL CIRCUIT

$$I = \frac{V}{Z}$$
$$V_L = IX_L$$
$$Z = \sqrt{R^2 + {X_L}^2}$$
$$\theta = \tan^{-1}\left[\frac{X_L}{R}\right]$$
$$Cos\ \theta = \frac{R}{Z}$$

RC CIRCUIT

$$I = \frac{V}{Z}$$
$$V_C = IX_C$$
$$Z = \sqrt{R^2 + {X_C}^2}$$
$$\theta = \tan^{-1}\left[\frac{X_C}{R}\right]$$
$$Cos\ \theta = \frac{R}{Z}$$

RLC CIRCUIT

$$I = \frac{V}{Z}$$
$$V_L = IX_L \quad V_C = IX_C \quad V_R = IR$$
$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$
$$\theta = \tan^{-1}\left[\frac{X_L - X_C}{R}\right]$$
$$Cos\ \theta = \frac{R}{Z}$$

AC MACHINES

$$N_S = \frac{120f}{P} \qquad \%S = \frac{N_S - N_R}{N_S} \times 100$$
$$Nr = N_S(1 - S) \qquad fr = Sf$$
$$E = 2.22 K_d K_p f \theta Z$$

TRANSFORMER

$$\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{I_S}{I_P} \qquad E_1 = 4.44 f N_1 \Phi_m \qquad E_2 = 4.44 f N_2 \Phi_m$$

$Complex\ Power, S(VA) = VI$

$Actual\ Power, P(W) = VI \cos\theta$

$\text{Re}\ active\ Power, Q(VAR) = VI \sin\theta$

$$I = \frac{Power}{Voltage}$$

$Power\ losses = Core\ lossess + {I_P}^2 R_P + {I_S}^2 R_S$

$Output\ Power = Power \times power\ factor$

$Input\ Power = Output\ power + power losses$

$$Efficiency, \%\eta = \frac{output\ power}{input\ power} \times 100$$

ELECTROMAGNET

$$H = \frac{Fm}{l} = \frac{NI}{l}$$
$$B = \frac{\Phi}{A}$$
$$B = \mu H$$
$$\mu = \mu_o \mu_r$$
$$S = \frac{Fm}{\Phi} = \frac{l}{\mu A}$$