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 I : 2024/2025

DJJ20053: ELECTRICAL TECHNOLOGY

TARIKH : 03 DISEMBER 2024
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **LAPAN (8)** 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. Answers **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1 (a) List **FOUR (4)** factors that influence the value of resistance and describe any **TWO (2)** of the factors listed.

*Senaraikan **EMPAT (4)** faktor yang mempengaruhi nilai rintangan dan jelaskan mana-mana **DUA (2)** faktor yang telah disenaraikan.*

[6 marks]

[*6 markah*]

CLO2 (b) A bread maker with 5kW power, 230V is used for baking 20 breads for half an hour. Express the value of:

Sebuah mesin pembakar roti dengan kuasa 5kW, 230V digunakan untuk membakar 20 buku roti dalam masa setengah jam. Nyatakan nilai bagi:

i. Current, I

Arus, I

[2.5 marks]

[*2.5 markah*]

ii. Resistance, R

Rintangan, R

[2.5 marks]

[*2.5 markah*]

iii. Electrical energy if the circuit is being used for half an hour, E

Tenaga elektrik jika litar digunakan selama setengah jam, E

[3 marks]

[*3 markah*]

CLO2

(c)

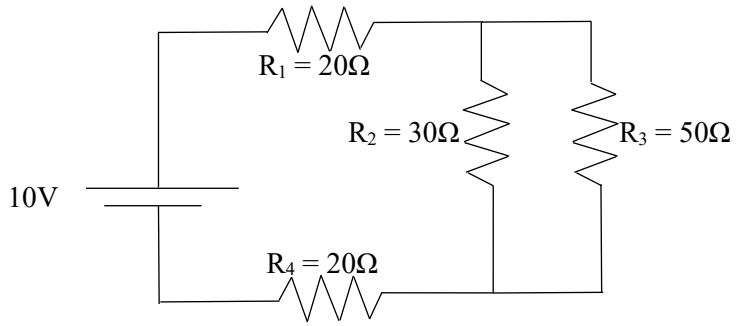

Figure 1(c)/ *Rajah 1(c)*

Referring to Figure 1(c), calculate the following values:
Merujuk kepada litar gabungan dalam Rajah 1(c) di bawah, kirakan nilai-nilai berikut:

i. Total resistance in the circuit, R_T
Jumlah rintangan di dalam litar, R_T

[5 marks]
[*5 markah*]

ii. Total current in the circuit, I_T
Jumlah arus di dalam litar, I_T

[3 marks]
[3 *markah*]

iii. Current flows in resistor R_2
Arus yang mengalir melalui R_2

[3 marks]
[*3 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Label a three phase (3Φ) sinusoidal waveform with the aid of diagram.
Label gelombang sinus tiga fasa (3Φ) dengan bantuan gambarajah.

[6 marks]
[*6 markah*]

CLO2 (b) Express the total value of capacitance for **FOUR (4)** capacitors with each of them having 120μF of capacitance connected in:
*Nyatakan jumlah kemuatan bagi **EMPAT (4)** pemuat dengan nilai kemuatan bagi setiap pemuat adalah 120μF apabila ia disambung secara:*

i. Series
Siri

[4marks]
[*4 markah*]

ii. Parallel
Selari

[3marks]
[*3 markah*]

CLO2 (c) Figure 2(c) below shows a coil of resistance 5Ω and inductance 120mH in series with a 100μF capacitor that is connected to a 300V, 50Hz supply. Calculate:
Rajah 2(c) di bawah menunjukkan satu gegelung mempunyai rintangan 5Ω dan kearuhan 120mH di sambung siri dengan pemuat 100μF, disambungkan kepada 300V, bekalan 50Hz. Kirakan:

i. Current flows in the circuit, I
Arus yang mengalir dalam litar, I

[8 marks]
[*8 markah*]

ii. Phase angle, θ
Sudut fasa, θ

[2 marks]
[*2 markah*]

iii. Voltage across the coil, V_L
Voltan merentasi gegelung, V_L

[2 marks]
[*2 markah*]

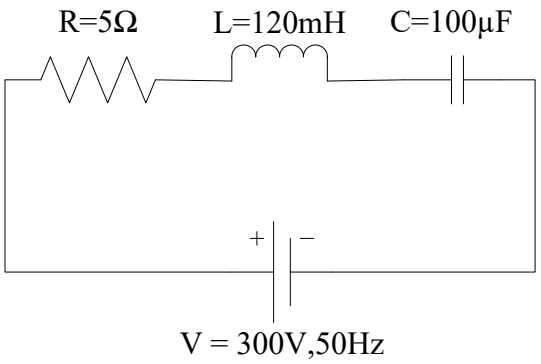

Figure 2(c)/ *Rajah 2(c)*

QUESTION 3
SOALAN 3

CLO1 (a) With the aid of a diagram, describe electromagnet (temporary magnet).
Dengan berbantukan gambarajah, terangkan mengenai elektromagnet (magnet sementara).

[6 marks]
[*6 markah*]

CLO2 (b) Visualize the magnetic field when two current carrying conductors are put nearby:

Lukiskan medan magnet yang terbentuk apabila dua pengalir pembawa arus diletakkan berdekatan:

i. Has current flow in the same direction in the two conductors.
Arus mengalir pada arah yang sama pada kedua-dua pengalir.

[4 marks]
[*4 markah*]

ii. Has current flow in the opposite direction in the two conductors.
Arus mengalir pada arah yang berlawanan pada kedua-dua pengalir.

[4 marks]
[4 *markah*]

CLO2 (c) A 250 mm long round iron core has a 110 mm^2 cross sectional area. It is wounded with 2000 turns of conductor. When measured, the flux produced in the iron core is 0.2mWb when 65mA of current flows through the wound. Calculate:

Sebuah teras besi bulat dengan panjang 250 mm mempunyai luas keratan rentas sebanyak 110 mm^2. Teras besi dililit dengan 2000 lilitan pengalir. Apabila diukur, nilai fluks yang terhasil di dalam teras besi adalah 0.2mWb apabila 65mA arus mengalir melaluinya. Kirakan:

i. Magnetic flux density, B
Ketumpatan fluks magnet, B

[4 marks]
[*4 markah*]

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

[4 marks]
[*4 markah*]

iii. Absolute permeability, μ_a

Ketelapan mutlak, μ_a

[3 marks]

[3 *markah*]

QUESTION 4

SOALAN 4

CLO1 (a) Describe briefly **TWO (2)** basic parts of AC machine.

*Terangkan secara ringkas **DUA (2)** binaan asas mesin AU.*

[6 marks]

[*6 markah*]

CLO2 (b) A 5 pole, 60 Hz induction motor is running on load with a slip of 5%. Express the value of:

Sebuah motor aruhan 5 kutub, 60 Hz dipacu pada beban penuh dengan 5% gelinciran. Nyatakan nilai bagi:

i. Synchronous speed, N_s

Kelajuan segerak, N_s

[3 marks]

[*3 markah*]

ii. Actual speed, N_r

Kelajuan sebenar, N_r

[2 marks]

[*2 markah*]

iii. Frequency of the rotor currents when the motor is starting and runs at full load.
Frekuensi arus pemutar apabila motor dihidupkan dan dipacu pada beban penuh.

[2marks]
[*2 markah*]

CLO2 (c) A single-phase transformer has a voltage ratio of 6:1 and high voltage winding is supplied at 540V. The secondary winding provides a full load current of 30A at a power factor of 0.8 lagging. Neglecting losses, calculate:
Pengubah fasa tunggal mempunyai nisbah voltan 6:1 dan lilitan voltan tinggi dibekalkan pada 540V. Lilitan sekunder membekalkan arus beban penuh pada 30A pada faktor kuasa 0.8 kebelakang. Abaikan kehilangan, tentukan:

i. Secondary voltage, V_s
Voltan sekunder, V_s

[4 marks]
[*4 markah*]

ii. Power supplied to load, P_s
Kuasa yang dibekalkan pada beban, P_s

[4 marks]
[*4 markah*]

iii. Primary current, I_p
Arus primer, I_p

[4 marks]
[*4 markah*]

SOALAN TAMAT

DJJ20053 – ELECTRICAL TECHNOLOGY

FORMULA

INTRODUCTION TO ELECTRICAL CIRCUITS

$$R = \frac{\rho \ell}{A} \qquad V = IR$$

$$P = IV \qquad E = Pt$$

$$C = \frac{Q}{V}$$

KIRCHOFF'S LAW

$V_J = V_1 + V_2 + V_3$

$\Sigma I_{IN} = \Sigma I_{OUT}$

$I_1 = I_2 + I_3$

SERIES

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

PARALLEL

$V_T = V_1 = V_2 = \ldots\ldots = Vn$
$I_T = I_1 + I_2 + \ldots\ldots\ldots + I_n$
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots + \frac{1}{R_n}$
$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \ldots\ldots + \frac{1}{L_n}$
$C_T = C_1 + C_2 + \ldots\ldots + C_n$
$Ix = \frac{R_T}{R_x} I_T$

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

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

AC MACHINES

$$N_s = \frac{120f}{P} \qquad \%S = \frac{N_s - N_r}{N_s} \times 100$$

$$N_r = Ns(1 - S) \qquad f_r = Sf$$

$$E = 2.22 K_d K_p f \phi Z$$

TRANSFORMER

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p} \qquad E_1 = 4.44 f N_1 \Phi_m$$

$$E_2 = 4.44 f N_2 \Phi_m$$

Complex Power, S (VA) = VI

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

Reactive Power,Q (VAR) = $VI \sin\theta$

I = Power / Voltage

Power losses = Core losses + $Ip^2Rp + Is^2Rs$

Output power = Power x power factor

Input power = output power + power losses

Efficiency,%η = output power / Input power x 100

ELECTROMAGNET

$$H = \frac{Fm}{l} = \frac{NI}{l}$$

$$B = \frac{\Phi}{A}$$

$$B = \mu H$$

$$\mu = \mu_o \mu_r$$

$$S = \frac{Fm}{\Phi} @ \frac{l}{\mu A}$$