SULIT

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

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI I : 2022 / 2023

DJJ20053: ELECTRICAL TECHNOLOGY

TARIKH : 20 DISEMBER 2022
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** 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)** questions. Answer **ALL** questions.

ARAHAN:

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

QUESTION 1

SOALAN 1

CLO1
C1

(a) Define resistance and identify **FOUR (4)** factors that affect the resistance value of a conductor.

*Takrifkan rintangan dan kenalpasti **EMPAT (4)** faktor yang mempengaruhi nilai rintangan bagi sesebuah konduktor.*

[6 marks]

[*6 markah*]

CLO2
C2

(b) The resistivity of the aluminium cylinder conductor is 2.65 μΩm, 1 mm radius and 30 Ω resistance, express the value of:

Sebuah konduktor aluminium berbentuk silinder mempunyai nilai kerintangan 2.65 μΩm, jejari 1mm dan 30 Ω rintangan. nyatakan nilai bagi:

i. Conductor length

Panjang konduktor

[6 marks]

[*6 markah*]

ii. Current flown through the conductor if the supply voltage is 35V

Arus yang mengalir melalui bahan konduktor sekiranya sumber bekalan ialah 35V

[2 marks]

[*2 markah*]

CLO2
C3

(c) Referring to **Figure 1(c)**, given R_1=10Ω, R_2=5Ω, R_3=5Ω, R_4=3Ω and R_5=7Ω calculate:

*Merujuk kepada **Rajah 1(c)**, diberi R_1=10Ω, R_2=5Ω, R_3=5Ω, R_4=3Ω dan R_5=7Ω kirakan:*

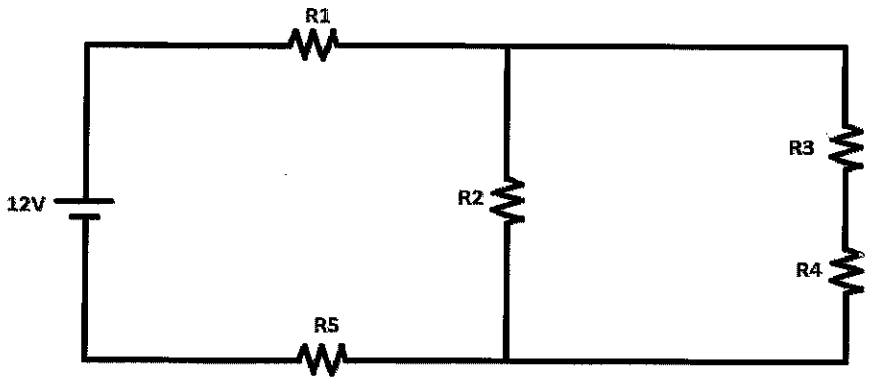

Figure 1(c) / *Rajah 1 (c)*

i. Total resistance, R_T
Jumlah rintangan, R_T

[6 marks]
[*6 markah*]

ii. Total current, I_T
Jumlah arus, I_T

[2 marks]
[*2 markah*]

iii. Total Power, P_T
Jumlah kuasa, P_T

[2 marks]
[*2 markah*]

iv. Current through resistor R_1
Arus yang melalui perintang R_1

[1 mark]
[*1 markah*]

QUESTION 2

SOALAN 2

CLO1 C1

(a) Define capacitance and describe **TWO (2)** factors that affect the capacitance value in a capacitor.

*Takrifkan kemuatan dan jelaskan **DUA (2)** faktor yang mempengaruhi nilai kemuatan dalam sesebuah pemuat.*

[6 marks]

[*6 markah*]

CLO2 C2

(b) Referring to **Figure 2(b)**, convert the difference phase waveform into the vector diagram and phasor diagram.

*Merujuk kepada **Rajah 2(b)**, tukarkan rajah gelombang tidak sefasa kepada gambarajah vektor dan gambarajah fasa.*

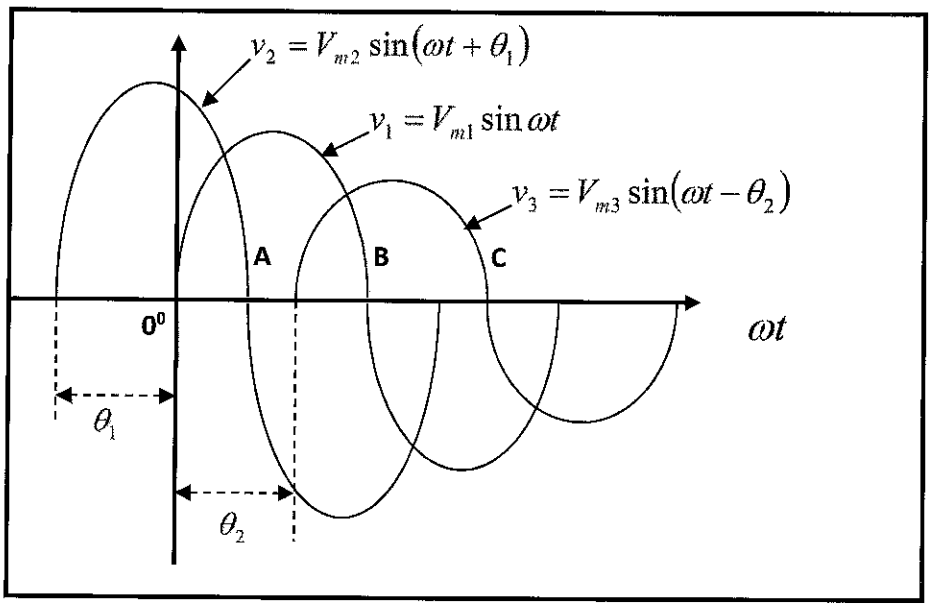

Figure 2(b) / *Rajah 2(b)*

[7 marks]

[*7 markah*]

CLO2
C3

(c) Referring to **Figure 2(c)**, calculate:
*Merujuk kepada **Rajah 2(c)**, kirakan:*

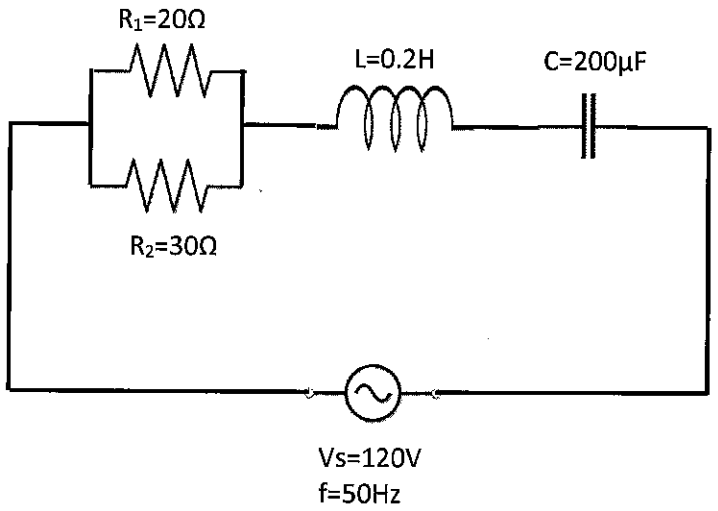

Figure 2(c) / *Rajah 2(c)*

i. Impedance, Z
Galangan, Z

[8 marks]
[*8 markah*]

ii. Current, I
Arus, I

[2 marks]
[*2 markah*]

iii. Phase angle, θ
Sudut fasa, θ

[2 marks]
[*2 markah*]

QUESTION 3

SOALAN 3

CLO1
C1

(a) Describe the electromagnetic effect with the aid of a suitable diagram when using **TWO (2)** current carrying conductors in a situation of:

*Terangkan kesan medan magnet dengan bantuan gambarajah yang bersesuaian apabila menggunakan **DUA (2)** konduktor yang membawa arus dalam keadaan:*

i. Same direction

Arah yang sama

[3 marks]

[3 *markah*]

ii. Different direction

Arah yang berlainan

[3 marks]

[*3 markah*]

CLO2
C2

(b) The maximum working flux density of a circular cross section electromagnet pole is 1.8T. If the total magnetic flux produced is 0.35 Wb, express the value of:

Ketumpatan flux maksimum satu tiang elektromagnet yang mempunyai keratan rentas berbentuk bulat ialah 1.8T. Sekiranya jumlah fluks magnet yang dihasilkan ialah 0.35 Wb, nyatakan nilai bagi:

i. Radius of the pole, r

Jejari tiang tersebut, r

[5 marks]

[*5 markah*]

ii. Absolute permeability, μ_a if relative permeability is 950
Ketelapan tetap, μ_a sekiranya ketelapan bandingan ialah 950

[3 marks]
[*3 markah*]

CLO2
C3

(c) A stainless steel cylinder of 100 cm length and crossed sectional area 5 cm^2 is wounded with 1000 turns of coil and 5A current flowing through it. The value of relative permeability is 1200, calculate:
Satu silinder besi mempunyai panjang 100 cm dan luas keratan permukaan 5cm^2 *dililit dengan 1000 lilitan pengalir dan arus sebanyak 5A melaluinya. Nilai ketelapan relatif adalah 1200, kirakan :*

i. Magnetomotive force, Fm
Daya gerak magnet, Fm

[2 marks]
[*2 markah*]

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

[2 marks]
[*2 markah*]

iii. Flux density, B
Ketumpatan fluks, B

[3 marks]
[3 *markah*]

iv. The value of flux, Φ
Nilai fluks, Φ

[2 marks]
[2 *markah*]

v. Reluctance, S
Engganan, S

[2 marks]
[*2 markah*]

QUESTION 4
SOALAN 4

CLO1
C1

(a) Describe **TWO (2)** differences between rotor and stator
*Terangkan **DUA (2)** perbezaan di antara rotor and stator*

[4 marks]
[*4 markah*]

CLO2
C2

(b) An alternating current (AC) generator with 5 pole, 400 V and 50 Hz run in a speed of 1160 rpm. It has 4 slots and 15 conductors/slot, express the value of:
Sebuah penjana AC 5 kutub, 400 V, 50 Hz bergerak dengan kelajuan sebanyak 1160 rpm. Ia mempunyai 4 slot dan 15 konduktor/slot, nyatakan nilai bagi:

i. Total number of conductors in the generator, Z
Jumlah konduktor dalam penjana, Z

[2marks]
[*2 markah*]

ii. Percentage slip in full load, %S
Peratus slip dalam keadaan beban penuh, %S

[4 marks]
[*4 markah*]

iii. Rotor frequency, fr
Frekuensi rotor, fr

[2 marks]
[*2 markah*]

CLO2
C3

(c) An ideal 10 kVA transformer has 100 turns on the secondary winding with 4000 V/ 200 V 60Hz . Calculate:

Sebuah pengubah ideal 10 kVA mempunyai 100 lilitan pada bahagian sekunder dengan 4000V/200V, 60Hz. Kirakan:

i. The primary and secondary current, I_P & I_S

Arus primer dan arus sekunder, I_P & I_S

[6 marks]
[*6 markah*]

ii. The number of primary turns, N_P

Bilangan lilitan primer, N_P

[4 marks]
[*4 markah*]

iii. The maximum value of flux, Ø

Nilai maksimum fluks, Ø

[3 marks]
[*3 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

$V_3 = V_1 + V_2 + V_3$

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

$I_1 = I_2 + I_3$

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) = $VI \sin\theta$

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

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

Output power = Power x power factor

Input power = output power + power losses

Efficiency,%η = $\frac{\text{output power}}{\text{Input power}}$ x 100

ELECTROMAGNET

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

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

$$B = \mu H$$

$$\mu = \mu_o \mu_r$$

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