SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI DISEMBER 2016

DJJ2022: ELECTRICAL TECHNOLOGY

TARIKH : 06 APRIL 2017
MASA : 8.30 AM – 10.30 AM (2 JAM)

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

(Struktur : 4 Soalan)

Dokumen sokongan yang disertakan: Rumus

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:

This paper consists of **FOUR (4)** structured questions. Answer all the question.

ARAHAN :

*Bahagian ini mengandungi **EMPAT (4)** soalan struktur. Jawab semua soalan.*

QUESTION 1

SOALAN 1

CLO1
C1

(a) List and explain briefly **FOUR (4)** factors that influence the value of resistance.
*Senarai dan terangkan secara ringkas **EMPAT (4)** faktor yang mempengaruhi nilai rintangan*

[6 marks]
[6 markah]

CLO1
C2

(b) Calculate the current flowing through aluminum wire with a length of 3 km and a diameter of 25 mm if the supply is 240 V. The resistivity of the wire is 0.28μΩm. Calculate the power used.
Kirakan arus yang mengalir melalui wayar aluminium dengan pangjang 3 km dan diameter 25 mm jika bekalan 240 v. Kerintangan wayar adalah 0.28 μΩm. Kirakan kuasa yang digunakan.

[10 marks]
[10 markah]

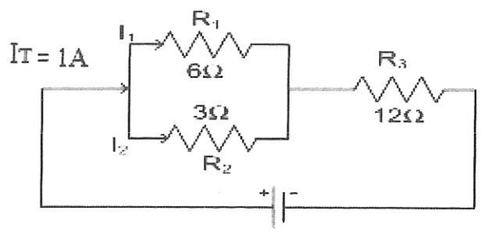

Figure 1c / *Rajah 1c*

CLO1
C4

(c) Referring to the Figure 1c;
Merujuk kepada Rajah 1c;

i) Using Ohm Law prove that $P = I^2R$
Menggnuakan Hukum Ohm buktikan $P=I^2R$

[2 marks]
[2 *markah*]

ii) Calculate total Power, P_T
Kira jumlah Kuasa, P_T

[5 marks]
[5 *markah*]

iii) Calculate voltage drop at resistor R_3
Kira voltan susut pada perintang R_3

[2 marks]
[*2 markah*]

QUESTION 2
SOALAN 2

CLO1
C1

(a) List down the **THREE (3)** factors that affecte the capacitance of the capacitor and explain each of them.
*Tuliskan **TIGA (3)** faktor yang mempengaruhi kapasitan kapasitor dan terangkan setiap satunya.*

[6 marks]
[*6 markah*]

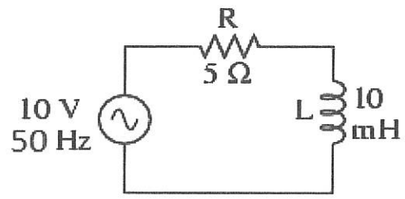

Figure 2
Rajah 2

CLO1
C2

(b) Referring to Figure 2, determine :
Merujuk kepada Rajah 2, kirakan :

i. Inductance value, V_L
Nilai kearuhan, R_L

[3 marks]
[3 markah]

ii. Impedance, Z
Galangan, Z

[4 marks]
[4 markah]

iii. Current flow in the circuit, I
Arus yang mengalir di dalam litar, I

[3 marks]
[3markah]

CLO1
C3

(c) The resistor and capacitor are connected in series with values of 50Ω and 150μF respectively. Given the supply voltage is 100VAC and frequency of 60Hz Calculate :
Sebuah perintang dan pemuat disambungkan secara sesiri dengan nilai 50Ω dan 150μF. Diberikan voltan bekalan 50VAU dan frekuensi 50Hz. Kirakan :

i. Capacitive Reactance
Regangan Berkemuatan

[3 marks]
[3 markah]

ii. Impedance (Z)
Galangan (Z)

[2 marks]
[2 markah]

iii. Total current circuit, IT
Jumlah arus mengalir dalam litar IT

[2 marks]
[2 markah]

iv. Power factor, cos Ø
Faktor kuasa, cos Ø

[2 marks]
[2 markah]

QUESTION 3
SOALAN 3

CLO1
C1

(a) Explain **THREE (3)** factors affecting the electromagnetic strength.
*Terangkan **TIGA(3)** faktor mempengaruhi kekuatan elektromagnet.*

[6 marks]
[6 markah]

CLO1
C2

(b) A mild steel ring has a diameter of 18cm and a cross sectional area of $5cm^2$. If the relative permeability is 1250, calculate :
Sekeping besi lembut berbentuk cincin mempunyai diameter 18 cm dan keluasan $5cm^2$. Jika ketelapan relatif diberi sebanyak 1250, kirakan :

i. The reluctance of the mild steel
Nilai engganan besi lembut tersebut

[3 marks]
[3 markah]

ii. The magnetomotive force required to produce a flux of 600μWb
Kekuatan daya magnet yang dperlukan untuk menghasilkan 600μWb fluks.

[2 marks]
[2 markah]

iii. Absolute permeability
Ketelapan mutlak.

[2 marks]
[2 markah]

CLO1
C3

(c) i) An iron ring has a cross- sectional area of 300mm^2 and a diameter of 15cm. it is wound with 500 turns. If the value of relative permeability is 200, calculate the magnetic field strength set up in the ring. The coil resistance is 374Ω and the supply voltage is 240V.

Satu cincin besi mempunyai luas keratan rentas 300mm^{2}dan diameter 15cm.ia mempunyai 500 lilitan. Jika nilai kebolehtelapan relative ialah 200, kirakan kekuatan medan magnet dalam cincin. Rintangan gegelung ialah 374Ω dan bekalan voltan ialah 240V.

[6 marks]
[6 *markah*]

ii) A mild steel ring has a radius of 60mm and a cross – sectional area of 500mm^2. A 0.5A of current flows in a coil wound around the ring and the flux produced is 0.1mWb. If the relative permeability is 250, calculate:

Sebuah gelang keluli lembut mempunyai jejari 60mm dan luas keratan rentas 500mm^2. Arus 0.5A mengalir melalui gelung yang dililit pada gelang tersebut dan fluks yang terhasil ialah 0.1mWb. Jika ketelapan bandingan ialah 250, kirakan;

a) Flux density, B
Ketumpatan fluks, B

[2 marks]
[*2 markah*]

b) Reluctance of the mild steel, S
Engganan bagi keluli lembut, S

[4 marks]
[*4 markah*]

QUESTION 4
SOALAN 4

CLO1
C1

(a) Define transformers and list down **TWO (2)** types of transformer losses.
*Berikan definisi transformer dan nyatakan **DUA (2)** jenis lesapan dalam transformer.*

[4 marks]
[4 markah]

CLO1
C3

(b) A transformer operates with a flux density of 1.25T has a 300V/1200V and 25Hz frequency. Calculate:
Sebuah pengubah beroperasi dengan ketumpatan fluks 1.25T mempunyai 300V/1200V dan 25Hz frekuensi. Kirakan:

i) The number of secondary winding if the primary winding is 80 turns
Bilangan lilitan sekunder sekiranya lilitan primer ialah 80 lilitan.

[5 marks]
[*5 markah*]

ii) The cross sectional area of the core
Luas keratan rentas teras besi

[5 marks]
[*5 markah*]

CLO1
C2

(c) A 5 pole , 300V, 50Hz alternating current (AC) generator runs on a speed of 750 rpm has 4 slots and 15 conductors/slot. If the useful flux is 15mWb, calculate:
Sebuah penjana AU 3 fasa, 5 kutub, 300V, 50Hz dipacu dengan 750 psm dimana pemutar mempunyai 4 lubang alur/fasa dan 15 pengalir/lubang alur. Jika fluks berguna ialah 15mWb, kirakan:

i. Total number of conductors in the generator, Z
Jumlah pengalir yang berada didalam penjana, Z

[2 marks]
[2 markah]

ii. Slip percentage in full load
Peratus gelinciran dalam beban penuh, %S

[5 marks]
[5 markah]

iii. Electromotive force, emf generated in the generator, E
Daya gerak elektrik, dge yang terhasil dalam penjana, E

[2 marks]
[2 markah]

iv. Rotor frequency, f_r
Frekuensi pemuter, f_r

[2 marks]
[2 markah]

Given, distribution factor. K_d= 1and pitch factor, K_p= 1
Diberi, faktor penghantaran, . K_d= 1dan factor 'pitch' factor, K_p= 1

SOALAN TAMAT

POLITEKNIK MALAYSIA

DJJ2022- ELECTRICAL TECHNOLOGY

INTRODUCTION TO ELECTRICAL CIRCUITS

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

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

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

AC MACHINES

$N_s = \frac{120f}{P}$ $\%S = \frac{N_s - N_r}{N_s} \times 100$
$N_r = Ns(1-S)$ $f_r = Sf$
$E = 2.22 K_d K_p f \phi Z$

TRANSFORMER

$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$ $E_1 = 4.44 f N_1 \Phi_m$
$E_2 = 4.44 f N_2 \Phi_m$

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

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