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 : 2022/2023

DJJ20053: ELECTRICAL TECHNOLOGY

TARIKH : 14 JUN 2023
MASA : 8.30 PG – 10.30 PG (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)** structured questions. Answer **ALL** questions.

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

QUESTION 1

SOALAN 1

CLO1

(a) Define the following terms and state their units.
Takrifkan istilah-istilah di bawah beserta unit.

i. Electromotive force (emf)
Daya gerak elektrik (dge)

[2 marks]
[*2 markah*]

ii. Current
Arus

[2 marks]
[*2 markah*]

iii. Resistance
Rintangan

[2 marks]
[*2 markah*]

CLO2

(b) An electric oven consumes 1.2kW of power. If the supply voltage is 240V, express the value of:
Sebuah ketuhar elektrik menggunakan kuasa sebanyak 1.2kW. Sekiranya sumber voltan ialah 240V, nyatakan nilai bagi:

i. Current flown in the oven, I
Arus yang mengalir dalam ketuhar tersebut, I

[2 marks]
[*2 markah*]

ii. Resistance of the heating coil, R
Rintangan pada gegelung pemanas , R

[3 marks]
[*3 markah*]

iii. Energy (Joule) consumed in 45 minutes
Tenaga (Joule) yang digunakan dalam masa 45 minit

[3 marks]
[*3 markah*]

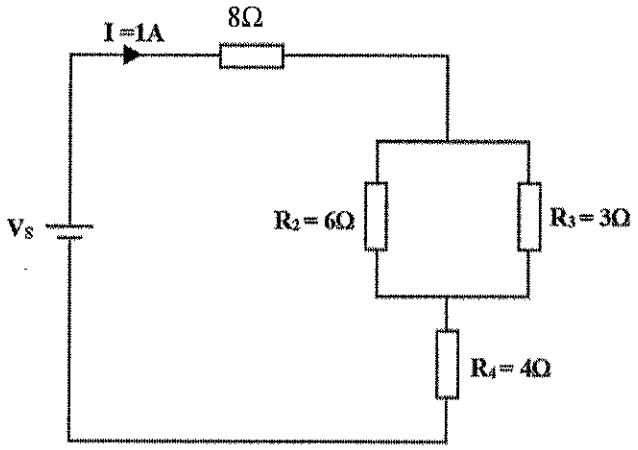

Figure 1(c)/ *Rajah 1(c)*

CLO2 (c) Referring to the combination circuit in **Figure 1(c)**, calculate:
*Merujuk kepada litar gabungan dalam **Rajah 1(c)**,* kirakan:

i. The total power, P_T
Jumlah Kuasa, P_T

[5 marks]
[*5 markah*]

ii. The voltage drop at R_1 and R_4 resistor
Voltan susut pada perintang R_1 dan R_4

[4 marks]
[*4 markah*]

iii. The supply voltage (Vs)
Voltan bekalan (Vs)

[2 marks]
[*2 markah*]

QUESTION 2
SOALAN 2

CLO1 (a) State **THREE (3)** differences between Inductor and Capacitor in term of function, symbols, and units.
*Nyatakan **TIGA (3)** perbezaan di antara Peraruh dan Pemuat merujuk kepada fungsi, simbol dan unit.*

[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

[4 marks]
[*4 markah*]

ii. Parallel
Selari

[3 marks]
[*3 markah*]

CLO2

(c) A RL series circuit has a 10Ω resistor, a 0.2H inductor and it is supplied with 250V, 50Hz AC.

Sebuah litar siri RL mempunyai 10 Ω perintang, 0.2 H peraruh dan voltan bekalan 250V, 50Hz AC.

i. Sketch the diagram of the series circuit

Lakarkan gambarajah litar sesiri tersebut

[2 marks]

[*2 markah*]

Calculate:

Kirakan:

ii. Impedance, Z

Galangan, Z

[4 marks]

[*4 markah*]

iii. Current, I

Arus, I

[2 marks]

[*2 markah*]

iv. Phase angle, Θ

Sudut fasa, Θ

[2 marks]

[*2 markah*]

v. Power factor, cos Θ

Faktor kuasa, kos Θ

[2 marks]

[*2 markah*]

QUESTION 3

SOALAN 3

CLO1 (a) Describe **THREE (3)** factors that affect the strength of magnetic field.
*Huraikan **TIGA (3)** faktor yang mempengaruhi kekuatan medan magnet.*

[6 marks]
[*6 markah*]

CLO2 (b) A current of 500mA is passed through a 600 turns coil wound at a toroid of mean diameter 10cm, express the value of:
Arus sebanyak 500mA mengalir menerusi sebuah toroid yang mempunyai 600, lilitan dengan diameter 10cm, nyatakan nilai bagi:

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

[4 marks]
[*4 markah*]

ii. Flux density,B if the flux produced is 20mWb
Ketumpatan fluks sekiranya fluks magnet yang dihasilkan ialah 20mWb

[4 marks]
[*4 markah*]

CLO2 (c) A ring iron core has a mean circumference of 250 mm and a cross sectional area of 110 mm^2. It is wound with 2000 turns. It was found through measurement, that the value of fluxs ini the iron is 0.2 mWb when 65 mA current flows through the winding. Calculate:
Satu teras besi berbentuk gelang yang mempunyai purata ukurlilit sebanyak 250 mm dan luas keratan rentas ialah 110 mm^2.Teras itu dililit dengan 2000 lilitan pengalir. Melalui pengukuran, didapati 0.2mWb fluks wujud apabila 65mA melalui lilitan tersebut. Kirakan:

Given the permeability of free space, $\mu_0=4\pi \times 10^{-7}$ H/m

Diberi nilai ketelapan ruang bebas, $\mu_0=4\pi \times 10^{-7}$ H/m

i. Magnetic field strength, H

Kekuatan medan magnet, H

[3 marks]

[*3 markah*]

ii. Absolute permeability, μ_a

Ketelapan bandingan, μ_a

[4 marks]

[*4 markah*]

iii. Relative permeability, μ_r

Ketelapan bandingan, μ_r

[2 marks]

[*2 markah*]

iv. Iron core reluctance,S

Engganan teras besi,S

[2 marks]

[*2 markah*]

QUESTION 4

SOALAN 4

CLO1 (a) State **TWO (2)** differences between DC and AC motors.

*Nyatakan **DUA (2)** perbezaan di antara motor DC dan AC.*

[4 marks]

[*4 markah*]

CLO2

(b) A 5 pole, 300 V, 50 Hz alternating current (AC) generator runs in a speed of 750 rpm, has 4 slots and 15 conductors/slots.If the flux used is 15mWb, express the value of:

Sebuah penjana AC 5 kutub, 300V, 50Hz bergerak dengan kelajuan sebanyak 750rpm, 4 slot dan mempunyai 15 konduktor/slot. Jika diberi nilai flux yang digunakan adalah 15mWb, nyatakan nilai bagi:

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

[2 marks]
[*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

(c) A 100kVA,4000 V/200 V, 50Hz single phase transformer has 100 secondary turns. Calculate:

Sebuah pengubah satu fasa 100kVA, 4000 V/200 V, 50Hz mempunyai lilitan sekunder sebanyak 100 lilitan. Kirakan:

i. The primary and secondary current, I_P & I_S
Arus primer dan arus sekunder, I_P & I_S

[4 marks]
[*4 markah*]

ii. The number of primary turns, N_P

Bilangan lilitan primer, N_P

[3 marks]
[*3 markah*]

iii. The maximum value of flux, ϕ

Nilai maksimum fluks, ϕ

[2 marks]
[*2 markah*]

iv. The turns of ratio required
Nisbah lilitan yang diperlukan

[2 marks]
[*2 markah*]

v. Referring to answer of Q4(c) iv, draw the type of transformer

Merujuk jawapan kepada Q4(c) iv, lukis jenis transformer.

[2 marks]
[*2 markah*]

SOALAN TAMAT

DJJ20053 – ELECTRICAL TECHNOLOGY

FORMULA

INTRODUCTION TO ELECTRICAL CIRCUITS

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

$P = IV$ $\quad E = Pt$

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

KIRCHOFF'S LAW

$V_s = V_1 + V_2 + V_3$

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

$I_1 = I_2 + I_3$

SERIES

$V_T = V_1 + V_2 + \ldots\ldots + V_n$

$I_T = I_1 = I_2 = \ldots\ldots = I_n$

$R_T = R_1 + R_2 + \ldots\ldots + R_n$

$L_T = L_1 + L_2 + \ldots\ldots + L_n$

$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots\ldots + \frac{1}{C_n}$

$Vx = \frac{R_x}{R_T} V_T$

PARALLEL

$V_T = V_1 = V_2 = \ldots\ldots = V_n$

$I_T = I_1 + I_2 + \ldots\ldots + I_n$

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots + \frac{1}{R_n}$

$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \ldots\ldots + \frac{1}{L_n}$

$C_T = C_1 + C_2 + \ldots\ldots + C_n$

$Ix = \frac{R_T}{R_x} I_T$

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

$I = \frac{V}{Z}$

$V_L = IX_L$ $\quad V_R = IR$

$V_C = IX_C$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$\theta = \tan^{-1}\left[\frac{X_L - X_C}{R}\right]$

$Cos\theta = \frac{R}{Z}$

AC MACHINES

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

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

$E = 2.22 K_a K_p f \phi Z$

TRANSFORMER

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

$E_2 = 4.44 f N_2 \Phi_m$

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, $\%\eta$ = output power / Input power x 100

ELECTROMAGNET

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

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

$B = \mu H$

$\mu = \mu_o \mu_r$

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