UNIVERSITI SAINS MALAYSIA

Peperiksaan Kursus Semasa Cuti Panjang
Sidang Akademik 2008/2009

Jun 2009

EEU 104 – TEKNOLOGI ELEKTRIK

Masa: 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEBELAS muka surat dan LIMA muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.

Kertas soalan ini mengandungi ENAM soalan.

Jawab **LIMA** soalan.

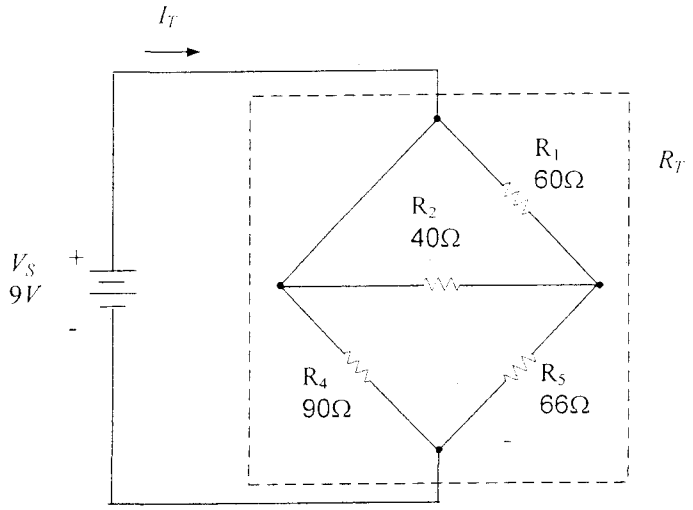
Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Agihan markah bagi setiap soalan diberikan di sudut sebelah kanan soalan berkenaan.

Jawab semua soalan dalam bahasa Malaysia atau bahasa Inggeris atau kombinasi kedua-duanya.

...2/-

1. (a)



Rajah 1
Figure1

Bahagian (a) adalah berdasarkan Rajah 1.

Part (a) is based on Figure 1.

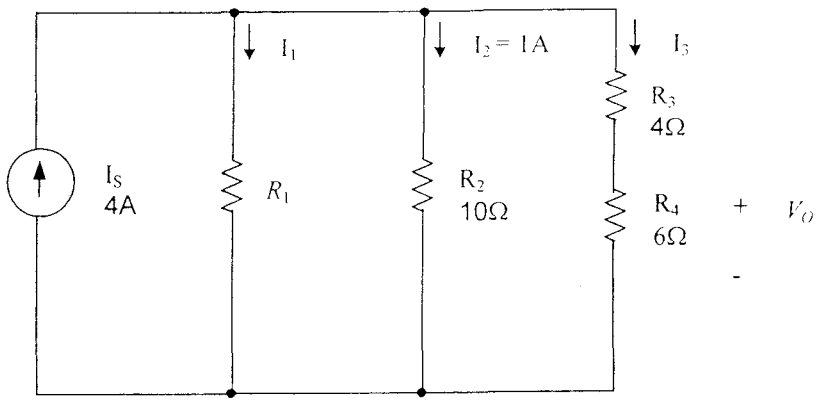
(i) Kirakan nilai jumlah rintangan, R_T.
Calculate the value of total resistance, R_T. (20%)

(ii) Kirakan nilai I_T.
Calculate the value of I_T. (10%)

(iii) Kirakan nilai kuasa yang dilesapkan oleh litar.
Calculate the power dissipated by the circuit. (10%)

...3/-

(b)



Rajah 2
Figure 2

Bahagian (b) adalah berdasarkan Rajah 2.
Part (b) is based on Figure 2.

(i) Tentukan nilai V_O.

Determine V_O. (15%)

(ii) Tentukan nilai I_3.

Determine I_3. (15%)

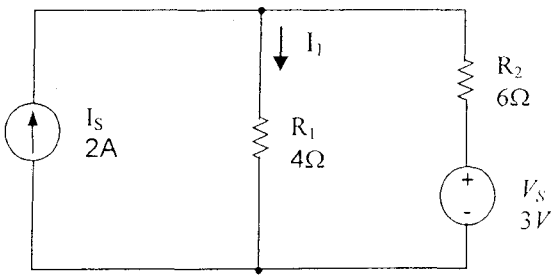
(iii) Tentukan nilai I_1.

Determine I_1. (15%)

(iv) Tentukan nilai R_1.

Determine R_1. (15%)

2.



Rajah 3
Figure 3

Tentukan nilai I_1 dalam Rajah 3 dengan menggunakan:

Determine the value of I_1 *in Figure 3 by using:*

(i) Teori superposisi.

Superposition theorem. (40%)

(ii) Analisis nod.

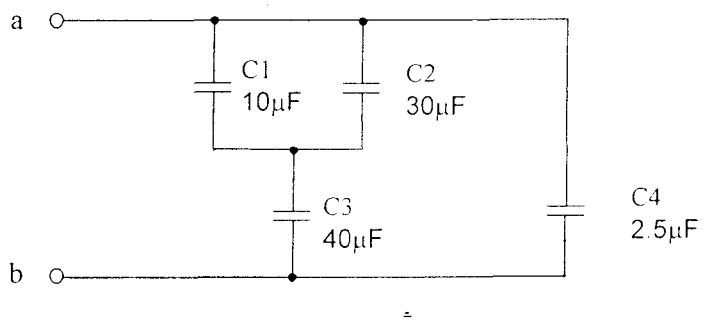
Nodal analysis. (30%)

(iii) Analisis gelung.

Mesh analysis. (30%)

3. (a) Dapatkan jumlah kemuatan terminal a-b dalam Rajah 4.

Find the total capacitance at terminal a-b in Figure 4.

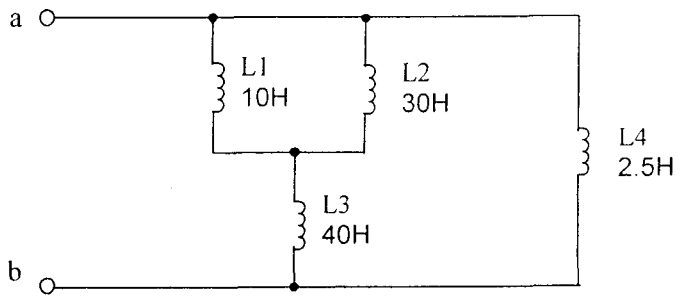


(20%)

Rajah 4
Figure 4

(b) Dapatkan jumlah kearuhan terminal a-b dalam Rajah 5.

Find the total inductance at terminal a-b in Figure 5.

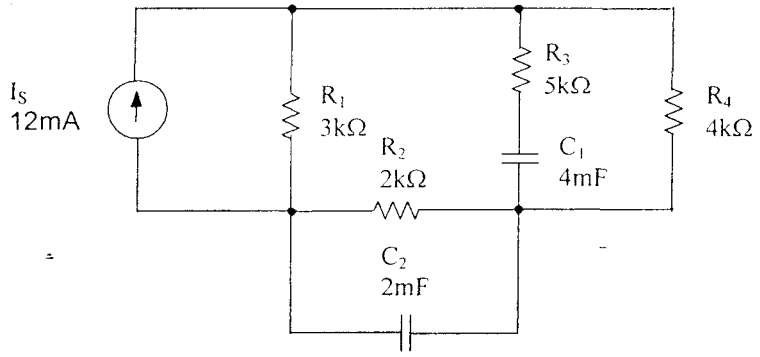


(20%)

Rajah 5
Figure 5

(c) Dapatkan jumlah tenaga yang disimpan setiap pemuat dalam Rajah 6 di bawah keadaan DC.

Obtain the energy stored in each capacitor in Figure 6 under DC conditions.

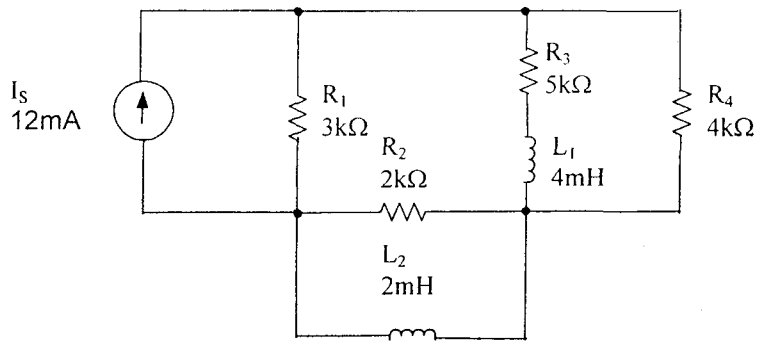


(30%)

Rajah 6
Figure 6

(d) Dapatkan jumlah tenaga yang disimpan setiap pengaruh dalam Rajah 7 di bawah keadaan DC.

Obtain the energy stored in each capacitor in Figure 7 under DC conditions.



(30%)

Rajah 7
Figure 7

4. Rajah 8 di bawah menunjukkan satu gelombang sinusoid untuk arus.

The Figure 8 below shows one sinusiodal waveform for current.

(a) Cari persamaan dalam fungsi masa untuk arus.

Find an equation as a function of time for the current. (30%)

(b) Sekiranya voltan adalah ketinggalan selama 5 ms, lukiskannya dalam rajah.

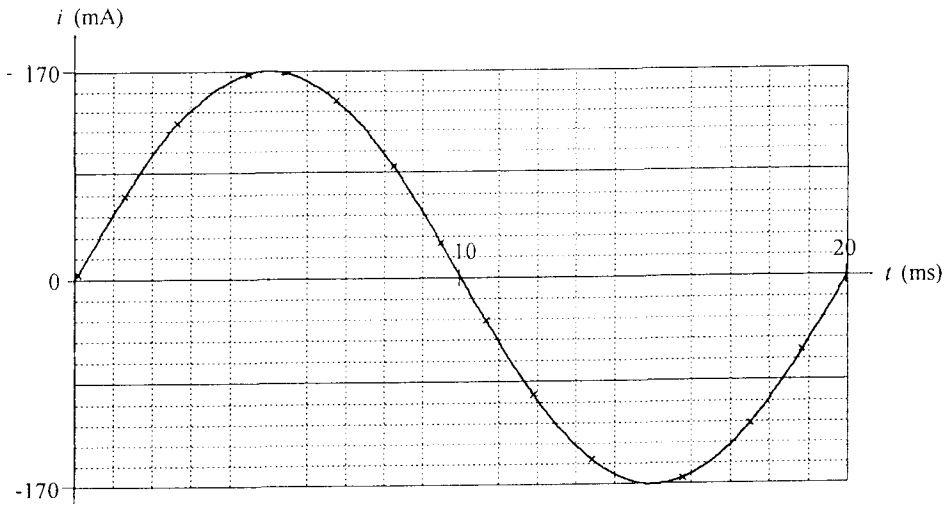
If a voltage is lagging the current by 5ms, draw the coresponding function on the diagram. Assume the amplitude is 240 mV and same frequency.

(20%)

(c) Cari persamaan dalam fungsi masa untuk voltan.

Find an equation as a function of time for the voltage.

(30%)



Rajah 8
Figure 8

(d) Satu sinusoid voltan a.c. mempunyai frekuensi sebanyak 2,500 Hz dan nilai puncak 15 V. Lukiskan a.c. voltan untuk satu period.

One sinusoidal a.c. voltage has frequency of 2,500 Hz and a peak value of 15 V. Draw the a.c. voltage waveform for one period.

(20%)

5. Untuk litar dalam Rajah 9 berikut;

For the circuit in Figure 9 below;

(a) Cari arus I dan nilai voltan V_R, V_L, dan V_C.

Find current I and voltages V_R, V_L, and V_C. (30%)

(b) Cari nilai kuasa yang dilesapkan oleh litar.

Find the power dissipated by the circuit. (10%)

(c) Lukiskan rajah pasor untuk I, V_R, V_L, V_C dan V.

Draw phasor diagram for I, V_R, V_L, V_C and V. (30%)

(d) Cari frekuensi resonan.

Find the resonant frequency. (10%)

(e) Cari nilai kuasa dilesapkan pada frekuensi resonan.

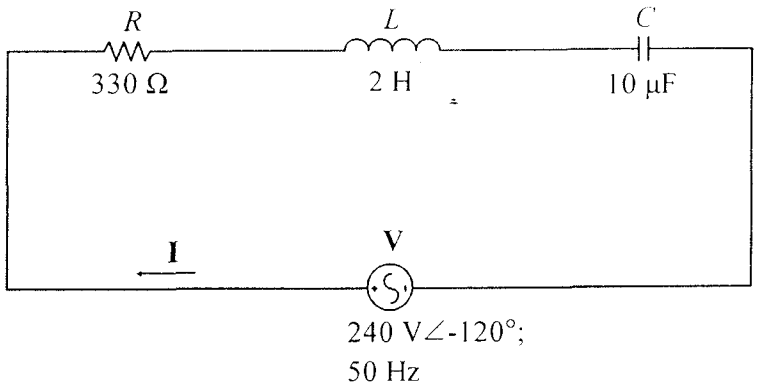
Find the power dissipated at resonant frequency. (10%)

(f) Cari "power factor".

Find the power factor. (5%)

(g) Adakah "power factor" mendahului atau ketinggalan?

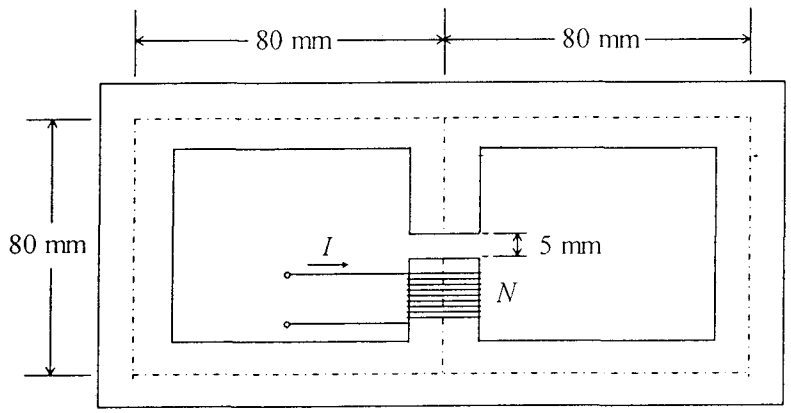
Is the power factor leading or lagging? (5%)



Rajah 9
Figure 9

6. (a) Bahan yang digunakan bagi teras dalam litar magnet dalam Rajah 10(a) mempunyai ketelapan relatif $\mu_r = 3500$. Keratan rentas teras adalah sekata pada keluasan 1000 mm^2. Panjang min bagi laluan fluks adalah seperti yang ditunjukkan dalam rajah. Kira ketumpatan fluks *B* dalam celah udara sekiranya $I = 20\,\text{A}$ dan $N = 300$ pusingan. Anda boleh mengabaikan kesan pinggiran dan fluks bocor.

The material used in the magnetic circuit in Figure 10(a) has a relative permeability $\mu_r = 3500$. *The core has a uniform cross-sectional area of 1000 mm*^{2}. *The mean path length of the flux is as shown in the figure. Calculate the flux density B in the air gap if* $I = 20\,\text{A}$ *and* $N = 300$ turns. *You may neglect the fringing effect and flux leakage.*

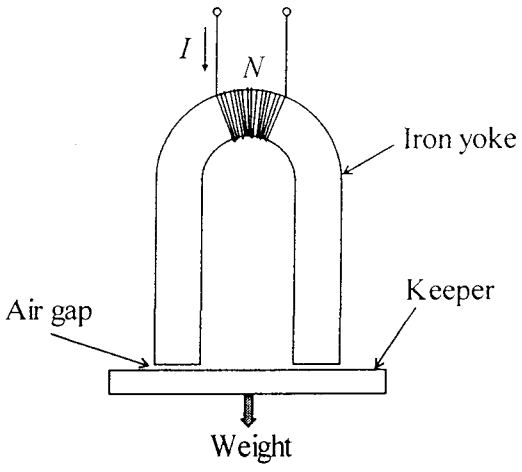


(50%)

Rajah 10
Figure 10

(b) Satu elektromagnet bentuk U seperti Rajah 11(b) direkabentuk untuk mengangkat satu jisim. Bahan yang digunakan untuk "*yoke*" mempunyai ketelapan relatif (μ_r) 2900. Keratan rentasnya adalah sekata dan mempunyai keluasan 4000 mm^2 dan panjang min ialah 600 mm sementara panjang setiap celah udara ialah 0.1 mm. Bilangan pusingan bagi gegelung (*N*) ialah 240. Dengan mengabaikan keengganan "keeper", kira jisim maksimum, dalam kg, yang mampu diangkat oleh sistem ini apabila arus sebanyak 1.5 A dialirkan melalui gegelungnya. Anda boleh mengabaikan kesan pinggiran dan fluks bocor.; dan andaikan $g = 9.81\,\text{m/s}^2$.

A U-shaped electromagnet shown in Figure 11(b) is designed to lift a mass. The material for the yoke has a relative permeability of 2900. The yoke has a uniform cross-sectional area of 4000 mm^2 and a mean length of 600 mm. Each of the air gaps is 0.1 mm long. The number of turns of the coil (N) is 240. Assuming that the reluctance of the keeper is negligible, calculate the maximum mass in kg, which can be lifted by the system if a current of 1.5 A is passed through the coil. You may neglect the fringing effect and flux leakage and assume that $g = 9.81\,\text{m/s}^2$.



(50%)

Rajah 11(b)
Figure 11(b)

oooooOooooo

1. $e = -1.602 \times 10^{-19}\,\mathrm{C}$

2. $i = \dfrac{dq}{dt}$

3. $Q = \int_0 i\,dt$

4. $v = \dfrac{dw}{dq}$

5. $w = F \times d$

6. $p = vi$

7. $P = F\dfrac{d}{t} = Fu;$ where u is a linear velocity

8. $P = Fu = Fr\dfrac{2\pi N}{t} = T\omega$ where ω is an angular velocity

9. Energizing current in an inductor.

$$i(t) = \frac{V_S}{R} + \left(I_0 - \frac{V_S}{R}\right)\exp\left(-\frac{(t-t_0)}{(L/R)}\right); \qquad v(t) = (V_S - I_0 R)\exp\left(-\frac{(t-t_0)}{(L/R)}\right)$$

10. De-energizing current in an inductor.

$$i(t) = (I_0)\exp\left(-\frac{(t-t_0)}{(L/R)}\right); \qquad v(t) = (-I_0 R)\exp\left(-\frac{(t-t_0)}{(L/R)}\right)$$

11. Charging a capacitor.

$$i(t) = \left(\frac{V_S - V_0}{R}\right)\exp\left(-\frac{(t-t_0)}{CR}\right); \qquad v(t) = V_S + (V_0 - V_S)\exp\left(-\frac{(t-t_0)}{CR}\right)$$

12. De-charging a capacitor.

$$i(t) = \left(-\frac{V_0}{R}\right)\exp\left(-\frac{(t-t_0)}{CR}\right); \qquad v(t) = (V_0)\exp\left(-\frac{(t-t_0)}{CR}\right)$$

13. Magneto-motive force: $m.m.f = NI = Hl = \Phi S$

14. $S = \dfrac{l}{\mu_r \mu_0 A}$ [ampere/weber]

15. $\Phi = B \times A$

16. $B = \mu_r \mu_0 H$

17. Star-connection:
$V_L = (\sqrt{3}) \times V_P$; $I_L = I_P$; $P = \sqrt{3} V_L I_L \cos\varphi$

18. Delta-connection:
$I_L = (\sqrt{3}) \times I_P$; $V_L = V_P$; $P = \sqrt{3} V_L I_L \cos\varphi$

19. Transformer:
$\dfrac{V_S}{V_P} = \dfrac{N_S}{N_P}$; $\dfrac{I_P}{I_S} = \dfrac{N_S}{N_P}$; $E = 4.44 N f \Phi_m$

No load current:
$I_0 = \sqrt{I_{om}^2 + I_{ol}^2}$; $\cos\phi_0 = \dfrac{I_{ol}}{I_o}$

Equivalent resistance and reactance:

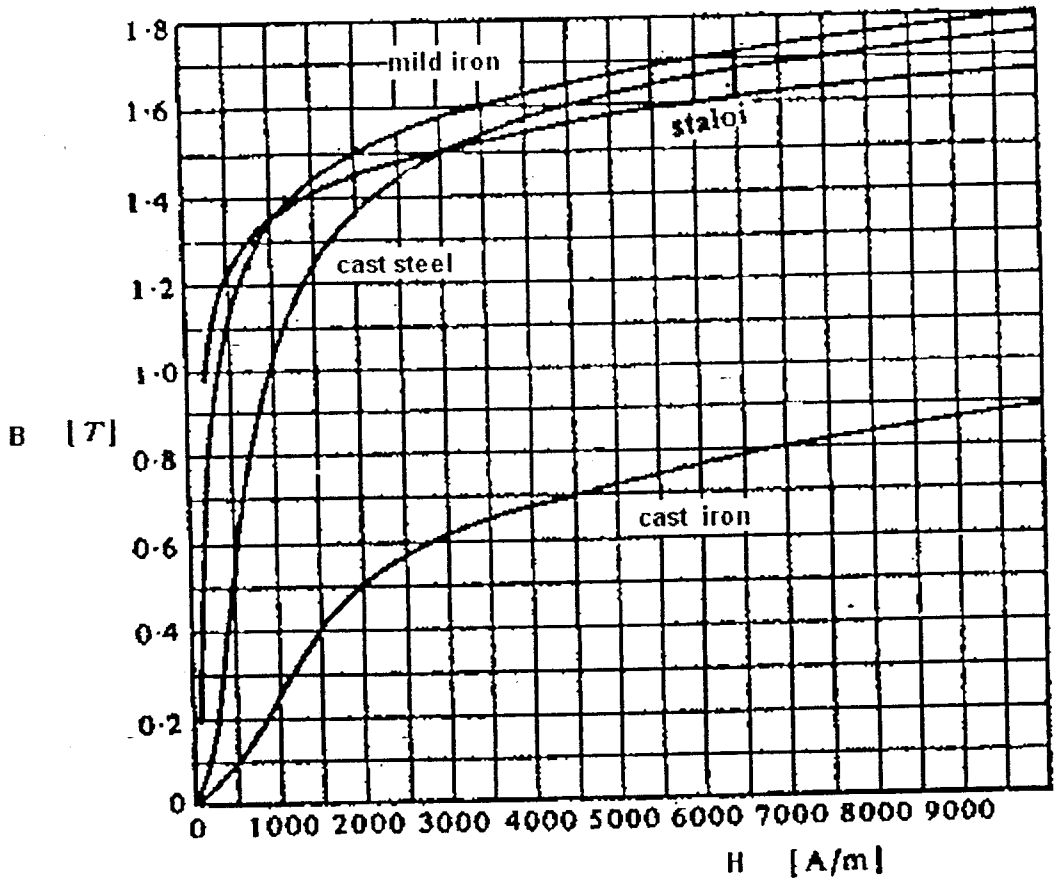
$$R_{e1} = R_1 + R_2\left(\frac{V_1}{V_2}\right)^2; \qquad X_{e1} = X_1 + X_2\left(\frac{V_1}{V_2}\right)^2$$

$$R_{e2} = R_2 + R_1\left(\frac{V_2}{V_1}\right)^2; \qquad X_{e2} = X_2 + X_1\left(\frac{V_2}{V_1}\right)^2$$

Voltage regulation:

$$\text{Voltage regulation} = \frac{I_1(R_e\cos\phi_2 + X_e\sin\phi_2)}{V_1} \quad \text{per unit}$$

$$\text{Voltage regulation} = \frac{V_1 - V_2\left(\frac{N_1}{N_2}\right)}{V_1} \quad \text{per unit}$$



B–H characteristic curves of various types of magnetic material

1. $C = \frac{Q}{V} \quad [F]$

2. $i_c = C\frac{dv_c}{dt}$

3. $v_c = \frac{1}{C}\int i_c dt$

4. $W = \frac{1}{2}CV^2$