UNIVERSITI SAINS MALAYSIA

Peperiksaan Kursus Semasa Cuti Panjang
Sidang Akademik 2006/2007

Jun 2007

EEU 104 – TEKNOLOGI ELEKTRIK

Masa: 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat dan TIGA muka surat LAMPIRAN 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) Sebuah cerek elektrik diperlukan untuk memanaskan 0.75 liter air dari 24°C ke suhu didih dalam masa 4 minit, dengan bekalan voltan yang diberikan 240V. Kecekapan cerek tersebut ialah 79.61 peratus. Dengan menganggapkan nilai muatan haba tentu air ialah 4190J/kgK dan 1 liter air mempunyai berat 1kg, kirakan:

An electric kettle is required to heat 0.75 liter of water from 24°C to boiling point in 4 minutes, the supply voltage being 240V. The efficiency of the kettle is 79.61 percent. By assuming the specific heat capacity of water to be 4190J/kgK and 1 liter of water have a mass of 1kg, calculate:

(i) Jumlah tenaga diperlukan untuk memanaskan air tersebut.
The total energy required to boil that water. (10%)

(ii) Kuasa masukan yang diperlukan.
The required input power. (20%)

(iii) Kerintangan bahagian pemanas;
The resistance of the heating element; (15%)

(iv) Kos jika kos tenaga yang digunakan pada kadar 21.8sen/kWh;
The cost of the energy consumed at 21.8cent/kWh; (15%)

(b) Kuasa yang dilesapkan oleh litar dalam Rajah 1 adalah sebanyak 1W. Kirakan:

Power dissipated by the circuit shown in Figure 1 is 1W. Calculate:

(i) Nilai I_S.

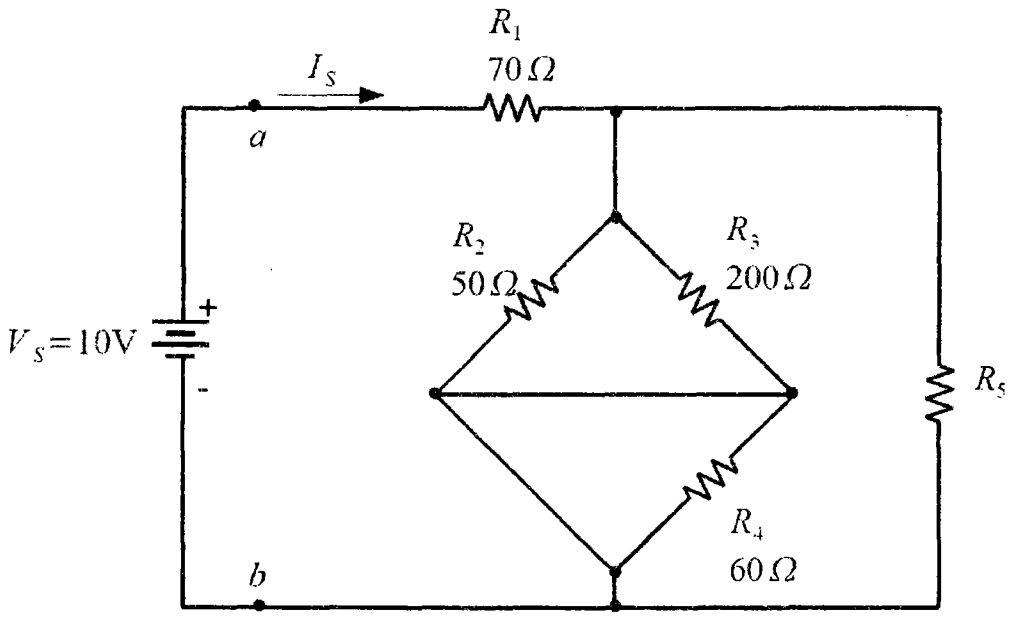
The value of I_S. (10%)

(ii) Nilai rintangan setara, R_{ab}.

The equivalent resistance, R_{ab}. (10%)

(iii) Nilai R_5.

The value of R_5. (20%)



Rajah 1
Figure 1

...4/-

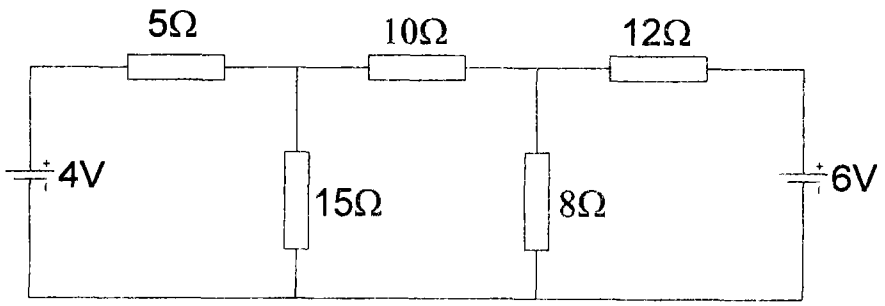
2. Berdasarkan litar yang ditunjukan dalam Rajah 2, kirakan arus yang melalui perintang 8Ω, menggunakan:

Based on the circuit shown in Figure 2, calculate the value of the current in the 8Ω resistor, by:

(i) Hukum Kirchoff
Kirchoff's law (30%)

(ii) Teori superposisi
Superposition theorem (30%)

(iii) Teori Thevenin
Thevenin theorem (40%)



Rajah 2
Figure 2

3. (a) Satu induktor 0.1H dengan rintangan yang boleh diabaikan, disambung secara bersiri dengan perintang 25Ω. Litar ini dibekalkan dengan sumber 230V, 50Hz.

A coil of inductance 0.1H and negligible resistance is connected in series with a 25Ω resistor. The circuit is energized from 230V, 50Hz source.

(i) Kirakan arus yang melalui litar.
Calculate the current in the circuit. (20%)

(ii) Kirakan voltan merentasi induktor.
Calculate the voltage across the inductor. (15%)

(iii) Kirakan voltan merentasi perintang.
Calculate the voltage across the resistor. (15%)

(iv) Jika sudut fasa bagi voltan merentasi perintang ialah 0^{o}, tentukan sudut fasa bagi voltan bekalan.

If the phase angle of the voltage across the resistor is 0^{o}, determine the phase angle of the voltage source.

(10%)

(v) Lukiskan rajah fasor (dengan skala) yang mewakili arus dan komponen-komponen voltan.
Draw to scale a phasor diagram representing the current and the component voltages.

(20%)

(b) Dapatkan hasil tambah keempat-empat voltan berikut. Jawapan anda mestilah di dalam domain masa.

Find graphically or otherwise the resultant of the following four voltages. Express the answer in a similar form.

e_1=25 sin ωt;

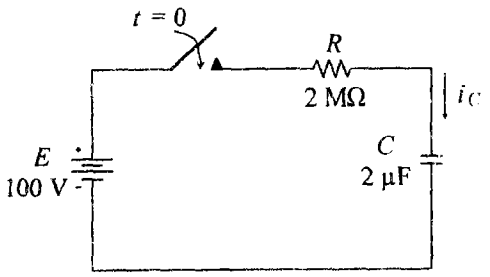
e_2=30 sin (ωt+π/6);

e_3= 30 cos ωt;

e_4= 20 sin (ωt-π/4). (20%)

4. Satu kapasitor bernilai 2μF disambungkan secara bersiri dengan perintang 2MΩ kepada satu bekalan voltan DC 100V, seperti ditunjukkan dalam Rajah 3. Kapasitor pada mulanya tidak bercas.

A 2μF capacitor is joined in series with a 2 MΩ resistor to a d.c. supply of 100V, as shown in Figure 3. The capacitor is initially uncharged.



Rajah 3
Figure 3

(a) Dapatkan nilai pemalar masa litar tersebut.
Find the time constant for the circuit. (10%)

(b) Dapatkan persamaan untuk mewakili voltan merentasi kapasitor pada t>0s.
Find the expression to present the voltage across the capacitor when t>0s.
(20%)

(c) Dapatkan persamaan untuk mewakili i_C pada t>0s.
Find the expression to present i_C, when t>0s.
(20%)

(d) Dapatkan nilai i_C pada masa t=10s.
Find the value of i_C when t=10s. (10%)

(e) Dapatkan nilai voltan merentasi kapasitor pada masa t=200s.
Find the value of the voltage across the capacitor when t=200s.
(10%)

(f) Dapatkan nilai tenaga yang disimpan kapasitor selepas 4s suis disambungkan.
Calculate the energy stored in the capacitor at the end of the interval of 4s from the start.
(30%)

5. Beban yang disambungkan pada bekalan sumber tiga fasa terdiri daripada tiga gegelung serupa, disambungkan secara bintang. Arus talian adalah 25A dan kuasa ketara dan kuasa aktif masing-masing adalah 20kVA dan 11kW. Kirakan voltan talian dan voltan fasa, kuasa reaktif masukan, dan nilai rintangan dan reaktan bagi setiap gegelung. Jika gegelung tersebut kemudiannya disambungkan secara delta, kepada bekalan sumber yang sama, kirakan nilai arus talian, dan nilai kuasa aktif yang digunakan.

The load connected to a three-phase supply comprises three similar coils connected in star. The line currents are 25A and the apparent and active power inputs are 20kVA and 11 kW respectively. Find the line and phase voltages, reactive power input and the resistance and reactance of each coil. If the coils are now connected in delta to the same three-phase supply, calculate the line currents and the active power taken.

(100%)

6. Satu transformer 10kVA satu fasa, 2000V/400V, semasa ketiadaan beban, mempunyai nilai-nilai rintangan dan reaktan bocor seperti berikut: Gelungan primer: rintangan, 5.5Ω; reaktan, 12Ω. Gelungan sekunder: rintangan, 0.2Ω, reaktan, 0.45Ω. Tentukan anggaran nilai voltan sekunder pada beban penuh dengan faktor kuasa 0.8 (mengikuti), apabila voltan bekalan yang diberikan ialah 2000V.

A 10 kVA single-phase transformer, for 2000V/400V at no load, has a resistances and leakage reactances as follows: Primary winding : resistance, 5.5Ω; reactance , 12Ω. Secondary winding: resistance , 0.2Ω; reactance , 0.45Ω. Determine the approximate value of the secondary voltage at full load, 0.8 power factor (lagging), when the primary supply voltage is 2000 V.

(100%)

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

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:
$V_L = (\sqrt{3}) \times V_P$; $\quad I_L = I_P$; $\quad P = \sqrt{3} V_L I_L \cos\varphi$

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

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

No load current:
$I_0 = \sqrt{I_{om}^2 + I_{o1}^2}$; $\quad \cos\phi_0 = \dfrac{I_{o1}}{I_o}$

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:

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

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