
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2012/2013 Academic Session

June 2013

EEK 241 – ELECTRICAL POWER TECHNOLOGY
[TEKNOLOGI ELEKTRIK KUASA]

Duration : 3 hours

[Masa : 3 jam]

Please check that this examination paper consists of **THIRTEEN (13)** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **TIGA BELAS (13)** mukasurat bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: This question paper consists **SIX (6)** questions. Answer **FIVE (5)** questions. All questions carry the same marks.

Arahan: *Kertas soalan ini mengandungi **ENAM (6)** soalan. Jawab **LIMA (5)** soalan. Semua soalan membawa jumlah markah yang sama.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

1. (a) Satu sukatan panjang 4m dipilih sebagai unit asas. Kira

A length of 4 m is selected as a base unit. Calculate

- (i) Panjang per unit untuk 1 batu

The per-unit length of 1 mile

- (ii) Nilai per unit untuk isipadu 6000 m³

The per-unit value of a volume of 6000 m³

- (iii) Nilai per unit untuk keluasan 2 batu persegi

The per-unit value of an area of 2 square miles.

(30 markah/marks)

- (b) Merujuk Rajah 1(b), tentukan sudut fasa di antara pemfasa berikut dan dalam setiap kes tandakan pemfasa mana yang menyusul

Referring to Fig 1(b), determine the phase angle between the following phasors and in each case indicate which phasor is lagging.

(i) I_1 dan I_3

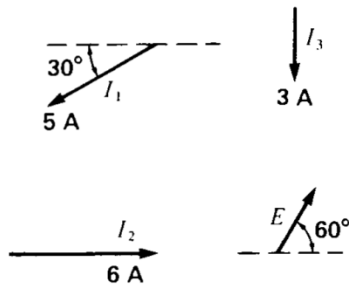
(ii) I_2 dan I_3

(iii) E dan I_1

(i) I_1 and I_3

(ii) I_2 and I_3

(iii) E and I_1



Rajah 1(b)

Figure 1(b)

(30 markah/marks)

- (c) Voltan yang dikenakan pada magnet ac diberi oleh hubungan $E=160 \sin \phi$ dan arus $I=20 \sin (\phi -60^\circ)$, semua sudut adalah dalam darjah.

The voltage applied to an ac magnet is given by expression $E=160 \sin \phi$ and the current is $I=20 \sin (\phi -60^\circ)$, all angle is expressed in degree.

- (i) Lukiskan rajah pemfasa untuk E dan I dengan menggunakan nilai berkesan

Draw the phasor diagram for E and I , using effective values.

- (ii) Lakarkan bentuk gelombang E dan I dalam fungsi ϕ

Sketch the waveshape of E and I as a function of ϕ

- (iii) Kira kuasa puncak positif dan negative

Calculate the peak positive power and peak negative power

(40 markah/marks)

2. (a) Penjana elektronik menghasilkan keluaran denyut voltan seperti ditunjukkan di Rajah 2(a). Jika voltan ini dikenakan merentasi perintang 10Ω , kira

An electronic generator produces the output voltage pulses as shown in Figure 2(a). If this voltage is applied across a 10Ω resistor, calculate

- (i) Kuasa puncak (W)

The peak power (W)

- (ii) Kuasa purata per kitar

The average power per cycle

- (iii) Nilai berkesan voltan

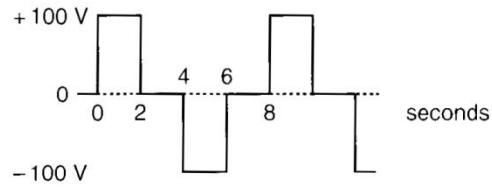
The effective value of the voltage

- (iv) Voltan purata

The average voltage

(50 markah/marks)

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Rajah 2(a)

Figure 2(a)

(b) Litar dalam Rajah 2(b) dibekal dari punca ac $E=1600 \angle 60^\circ$. Kira

The circuit of Figure 2(b) is powered by an ac source $E=1600 \angle 60^\circ$. Calculate

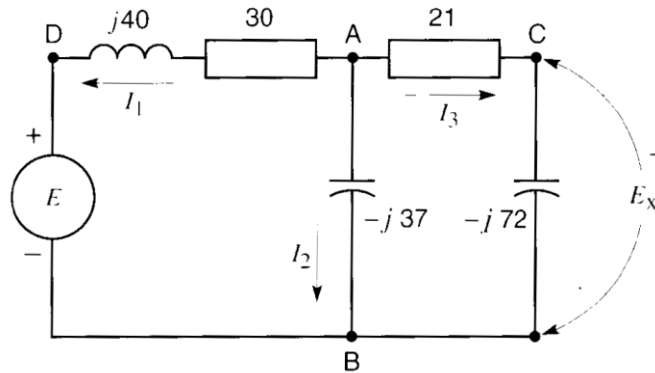
(i) Arus yang mengalir dalam setiap elemen

The current flowing in each element

(ii) Voltan E_x merentasi reaktans kapasitif 72Ω .

The voltage E_x across the 72Ω capacitive reactance.

(50 markah/marks)



Rajah 2(b)

Figure 2(b)

3. (a) Reaktans 10Ω disambung ke talian $120V$, 60 Hz . Kira
 10Ω reactance is connected to a $120V$, 60 Hz line. Calculate:

(i) Kuasa reaktif yang diserap oleh reactor
The reactive power absorbed by the reactor

(ii) Kuasa ketara yang diserap oleh reactor
The apparent power absorbed by the reactor

(iii) Kuasa puncak keluaran dari reaktor
The peak power output of the reactor

(40 markah/marks)

- (b) Motor satu fasa menerima arus 16A dari talian 240V, 60 Hz. Satu meter watt disambung ke talian yang menunjukkan bacaan 2765W.

A single phase motor draws a current of 16 A from a 240V, 60 Hz line. A wattmeter connected into the line which gives a reading of 2765W

- (i) Kira faktor kuasa motor dan kuasa reaktif yang diserapnya.

Calculate the power factor of the motor and the reactive power it absorbs.

- (ii) Jika satu kapasitor mempunyai reaktans 30Ω disambung selari dengan motor kira jumlah kuasa reaktif dan faktor kuasa bagi kedua-dua kapasitor dan motor

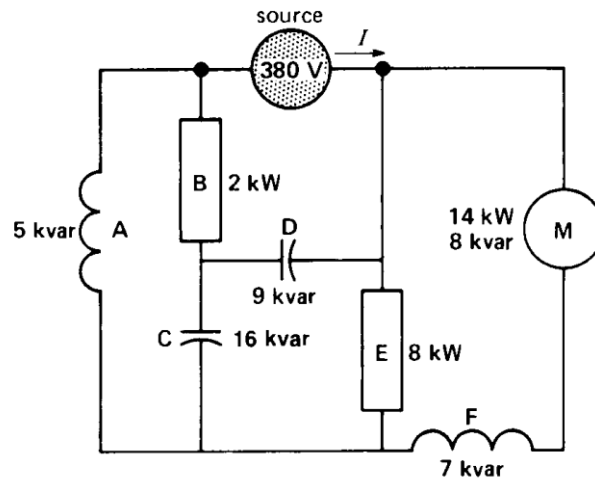
If a capacitor having a reactance of 30Ω is connected in parallel with the motor calculate the total reactive power absorbs and power factor of both capacitor and motor.

(40 markah/marks)

- (c) Lakarkan segitiga kuasa untuk sistem yang ditunjukkan oleh Rajah 3(c) jika keluaran motor digantikan dengan kadaran 20kW, 10kVar.

Draw the power triangle of the system given in Figure 3(c) if the motor output is replaced by 20 kW, 10kvar rating.

(60 markah/marks)



Rajah 3(c)

Figure 3(c)

4. (a) Dua waltmeter satu fasa disambung pada talian 3 fasa 220V menunjukkan bacaan 3.5kW dan 1.5kW masing-masing. Jika arus talian ialah 16A, kira yang berikut:

Two single-phase wattmeters connected into a 3-phase, 3 wire 220V line indicate 3.5 kW and 1.5kW respectively. If the line current is 16 A. calculate the following:

- (i) Kuasa ketara

The apparent power

- (ii) Faktor kuasa beban

The power factor of the load

(20 markah/marks)

(b) Voltan di antara talian a-b-c dalam Rajah 4(b) ialah 620V

The voltage between lines a-b-c of Figure 4(b) is 620V.

(i) Apakah voltan merentasi setiap perintang?

What is the voltage across each resistor?

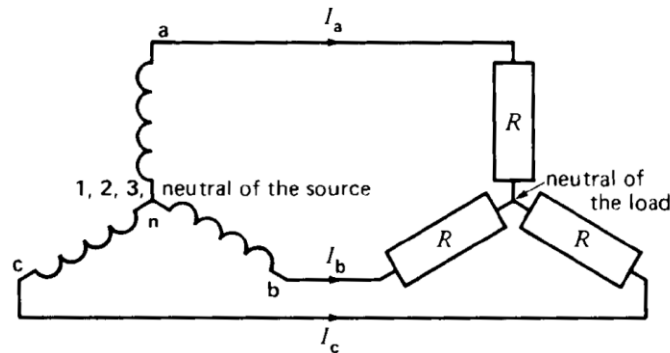
(ii) Jika $R = 15\Omega$, tentukan arus dalam setiap talian

If $R = 15\Omega$, what is the current in each line?

(iii) Kira kuasa yang dibekalkan ke beban 3 fasa

Calculate the power supplied to the 3 phase load.

(40 markah/marks)



Rajah 4(b)

Figure 4(b)

- (c) Loji industri menerima 600 kVA dari talian 2.4 kV yang mempunyai faktor kuasa menyusul 80%.

An industrial plant draws 600 kVA from a 2.4 kV line at a power factor of 80% lagging

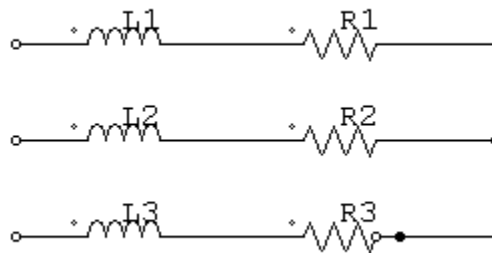
- (i) Apakah impedans setara talian ke neutral loji tersebut

What is the equivalent line to neutral impedance of the plant?

- (ii) Andaikan loji tersebut boleh diwakili oleh litar setara seperti ditunjukkan oleh Rajah 4(c), tentukan nilai perintang dan reaktans.

Assuming that the plant can be represented by an equivalent circuit similar to Figure 4(c), determine the value of the resistance and reactance.

(40 markah/marks)



Rajah 4(c)

Figure 4(c)

5. (a) Voltan piawai dikumpulkan dalam 4 kelas utama. Namakan mereka dan catatkan voltan penghampiran bagi setiap julat

Standard voltages are grouped into four main classes. Name them and state the approximate voltage of each range.

(20 markah/marks)

- (b) Talian penghantaran satu fasa mempunyai reaktans induktif 15Ω . Ia dibekalkan oleh punca $E_s=6000\text{ V}$.

A single phase transmission line possesses an inductive reactance of 15Ω . It is supplied by a source $E_s = 6000\text{V}$.

- (i) Kira voltan E_R pada hujung talian untuk beban kapasitif berikut: 285Ω dan 45Ω

Calculate the voltage E_R at the end of the line for the following capacitive loads: 285Ω dan 45Ω

- (ii) Kira sudut fasa di antara E_R dan E_S untuk beban 45Ω .

Calculate the phase angle between E_R and E_S if the load is 45Ω .

(40 markah/marks)

- (c) Huraikan kaedah bagi menaikkan keupayaan kuasa untuk talian penghantaran yang agak jauh (Berikan pengiraan untuk menyokong huraian anda. Andaikan talian voltan tinggi adalah induktif yang mempunyai reaktans bernilai $0.5\Omega/\text{km}$)

Explain the methods to increase the power capacity in transmission line over great distances (Give some calculation to support your explanation. Assume high voltage line is mainly inductive which possessing a reactance of about $0.5\Omega/\text{km}$)

(40 markah/marks)

6. (a) Takrifkan kategori-kategori dalam standard pengukuran. Jelaskan bagaimana alat pengukuran elektrik boleh diklasifikasikan berdasarkan penggunaan mereka.

Define the categories of measurement standards. Explain how the electrical measuring instruments can be categorised based on their use.

(30 markah/marks)

- (b) Dengan bantuan gambarajah, terangkan prinsip dasar operasi wattmeter jenis elektrodinamik. Lukis dan jelaskan bagaimana kuasa aktif bagi satu sistem 3-fasa 4-wayar boleh diukur dengan menggunakan wattmeter

With the help of a diagram, explain the principle of operation of an electrodynamic type wattmeter. Draw and explain how the active power of a 3-phase 4-wire system can be measured using wattmeters.

(30 markah/marks)

- (c) Satu watt-hourmeter digunakan untuk menentukan kuasa satu pemanas elektrik. Dengan hanya pemanas elektrik disambungkan, cakera meter membuat 15 pusingan lengkap dalam satu minit. Jika nilai K_h untuk meter tersebut ialah 2.8, kirakan kuasa pemanas elektrik.

A watt-hourmeter is used to measure the power of an electric heater. With only the heater connected, the disc of the meter makes 15 complete turns in one minute. If K_h of the meter is 2.8, calculate the power of the heater.

(25 markah/marks)

- (d) Senaraikan tiga langkah keselamatan untuk mengelakkan kejutan elektrik semasa menggunakan peralatan elektrik di makmal kuasa

List three safety measures to prevent electric shock while working on the electrical equipment in the power laboratory

(15 markah/marks)

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