CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	:	LED 10403
COURSE NAME	:	ELECTRIC CIRCUITS
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	DIPLOMA OF ENGINEERING TECHNOLOGY IN ELECTRICAL AND ELECTRONICS (MARINE)
DATE	:	26 MAY 2016
TIME	:	09.00 A.M. – 12.00 P.M.
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) sections; Section A and Section B.
4. Answer ALL questions in Section A. For Section B, answer TWO (2) questions only.
5. Please write your answers on the answer booklet provided.
6. Answer should be written in blue or black ink except for sketching, graphic and illustration.
7. Answer all questions in English language ONLY.

THERE ARE 8 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer all questions.
Please use the answer booklet provided.

Question 1 [CLO 1, 2]

a) Referring to Figure 1, determine the current and power in the 8-Ω resistor by using Source Transformation and KVL.

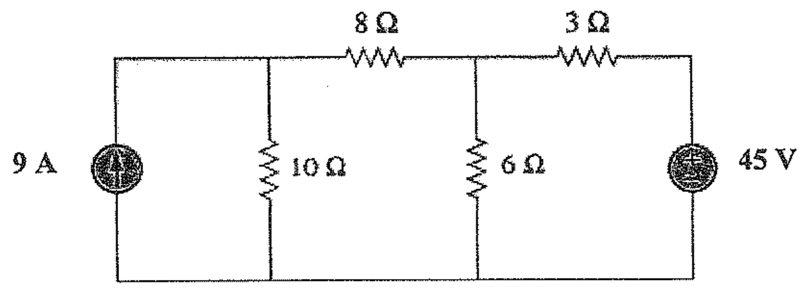


Figure 1

(9 marks)

b) For circuit in Figure 2:

i. Determine R_{Th} and V_{Th} at terminals 1-2.

(3 marks)

ii. A load is connected to the network. Find the maximum possible power supplied to the load.

(3 marks)

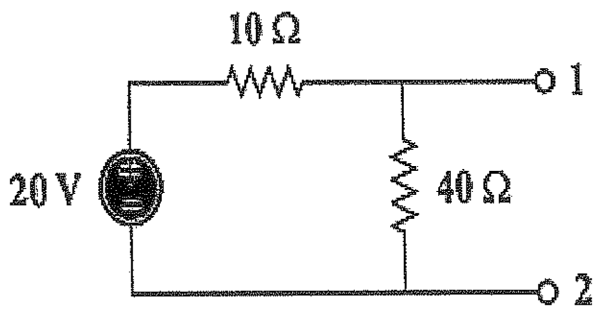


Figure 2

Question 2 [CLO 1, 2]

a) Given the sinusoidal voltage v(t) = 5 sin ($4\pi t$ - 60^0) V, state:

i. The amplitude of the voltage.

ii. The phase.

iii. The angular frequency.

iv. Period.

v. Frequency.

(5 marks)

b) Find input impedance (Z_{in}) in the circuit in Figure 3 below.

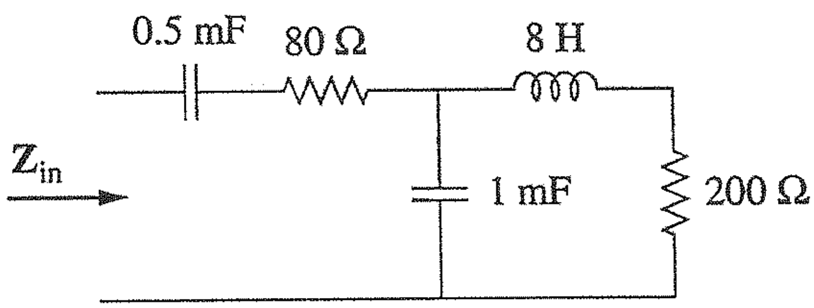


Figure 3

(5 marks)

c) A series RC circuit has $R = 50\Omega$ and $C = 4\,mF$. If the input voltage is $v(t) = 180\cos(20t + 60^0)V$, find the current flowing through the circuit.

(5 marks)

Question 3 [CLO 3]

a) Define bandwidth at the series resonant frequency. Hence, sketch the bandwidth.

(5 marks)

b) For a parallel RLC circuit with R = 40 Ω, L = 2 mH and C = 10 μF, calculate:

i. the resonance frequency, f_r

ii. the quality factor, Q

iii. the bandwidth, BW

iv. the half-power frequencies, f_1 and f_2

(10 marks)

Question 4 [CLO 1, 2]

a) Draw TWO (2) possible configurations of three-phase voltage sources. Show all the line and phase voltages of the configurations.

(5 marks)

b) A balanced Y-load having a 30 Ω resistance in each leg is connected to a three-phase Y-connected generator having a line voltage of 120 V. Calculate the magnitude of:

i. The phase voltage of generator

(4 marks)

ii. The phase current of the load

(4 marks)

iii. The line current

(2 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO (2) questions ONLY.
Please use the answer booklet provided.

Question 5 [CLO 2, 3]

a) A circuit with a supernode is shown in Figure 4. Determine the node voltages using nodal analysis.

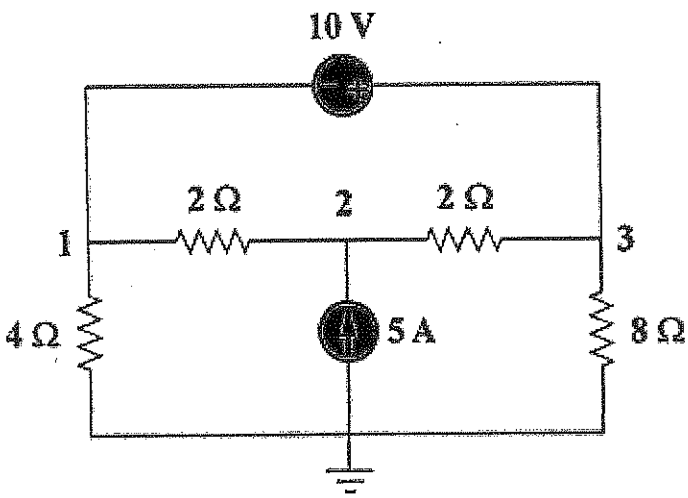


Figure 4

(10 marks)

b) A 110-V rms, 60-Hz source is applied to a load impedance Z. The apparent power entering the load is 120 VA at a power factor of 0.707 lagging.

i. Calculate the complex power.
ii. Find the rms current supplied to the load.
iii. Determine Z.
iv. Assuming that $Z = R + j\omega L$, find the values of R and L.

(10 marks)

Question 6 [CLO 2, 3]

a) Use mesh analysis to determine V_o in the circuit of Figure 5.

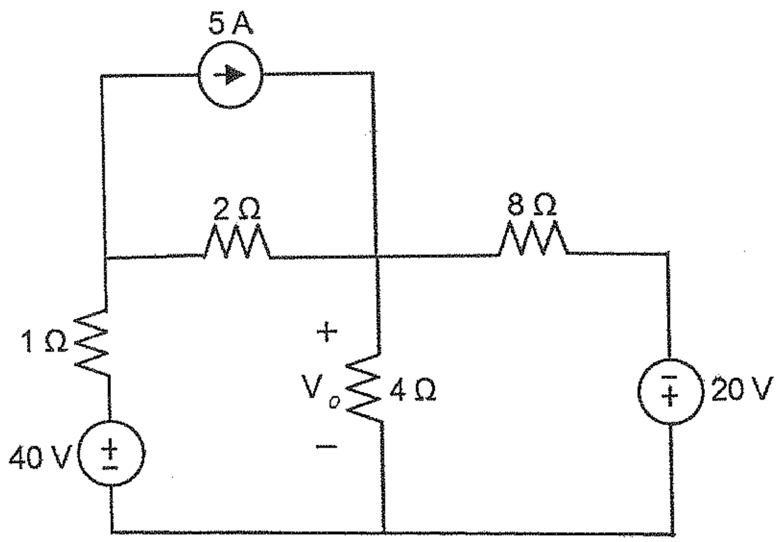


Figure 5

(10 marks)

b) Refer to the circuit shown in Figure 6:

i. Find the power factor.

ii. Calculate the average power dissipated.

iii. Determine the value of the capacitance that will give a unity power factor when connected to the load.

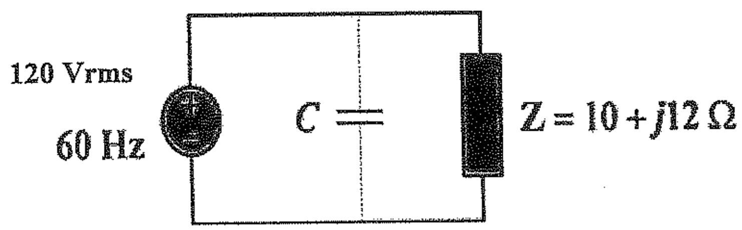


Figure 6

(10 marks)

Question 7 [CLO 2, 3]

a) If $V_{an} = 440 \angle 60^0$ in the network of Figure 7, find the load phase currents I_{AB}, I_{BC}, and I_{CA}.

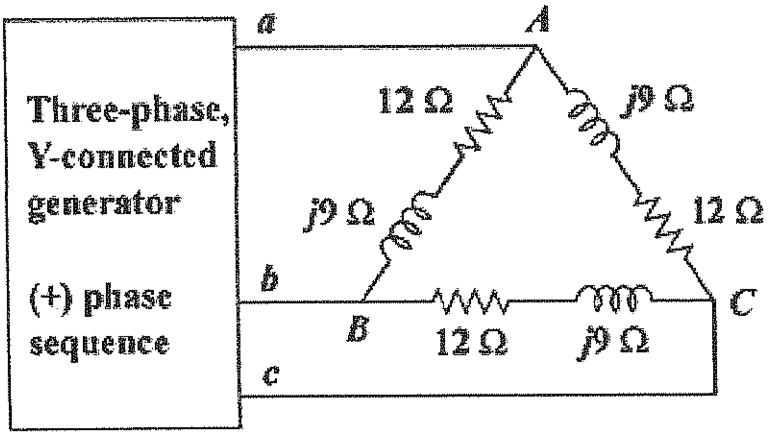


Figure 7

(10 marks)

b) A balanced Y-connected load has an impedance of (30 + j60) Ω per phase. With a line voltage of $240 \angle 0^0 \ V_{rms}$, calculate the total real power, reactive power, apparent power and power factor.

(10 marks)

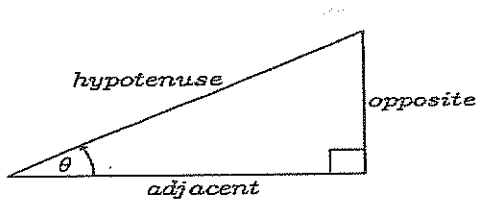
END OF QUESTIONS

TRIGONOMETRIC FORMULA SHEET

Right Triangle Definition

Assume that:

$0 < \theta < \frac{\pi}{2}$ or $0° < \theta < 90°$



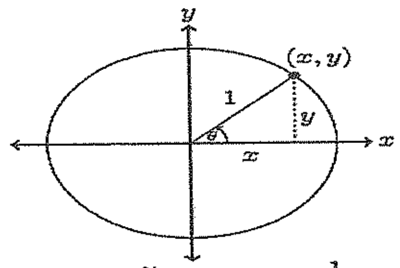
$\sin\theta = \frac{opp}{hyp}$ $\quad \csc\theta = \frac{hyp}{opp}$

$\cos\theta = \frac{adj}{hyp}$ $\quad \sec\theta = \frac{hyp}{adj}$

$\tan\theta = \frac{opp}{adj}$ $\quad \cot\theta = \frac{adj}{opp}$

Unit Circle Definition

Assume θ can be any angle.



$\sin\theta = \frac{y}{1}$ $\quad \csc\theta = \frac{1}{y}$

$\cos\theta = \frac{x}{1}$ $\quad \sec\theta = \frac{1}{x}$

$\tan\theta = \frac{y}{x}$ $\quad \cot\theta = \frac{x}{y}$

Periods of the Trig Functions

The period of a function is the number, T, such that $f(\theta + T) = f(\theta)$.

So, if ω is a fixed number and θ is any angle we have the following periods.

$\sin(\omega\theta) \Rightarrow T = \frac{2\pi}{\omega}$ $\quad \csc(\omega\theta) \Rightarrow T = \frac{2\pi}{\omega}$

$\cos(\omega\theta) \Rightarrow T = \frac{2\pi}{\omega}$ $\quad \sec(\omega\theta) \Rightarrow T = \frac{2\pi}{\omega}$

$\tan(\omega\theta) \Rightarrow T = \frac{\pi}{\omega}$ $\quad \cot(\omega\theta) \Rightarrow T = \frac{\pi}{\omega}$

Complex Numbers

$i = \sqrt{-1} \quad i^2 = -1 \quad i^3 = -i \quad i^4 = 1$

$\sqrt{-a} = i\sqrt{a},\ a \geq 0$ $\quad (a+bi)(a-bi) = a^2 + b^2$

$(a+bi)+(c+di) = a+c+(b+d)i$ $\quad |a+bi| = \sqrt{a^2+b^2}$ Complex Modulus

$(a+bi)-(c+di) = a-c+(b-d)i$ $\quad \overline{(a+bi)} = a - bi$ Complex Conjugate

$(a+bi)(c+di) = ac - bd + (ad+bc)i$ $\quad \overline{(a+bi)}(a+bi) = |a+bi|^2$

Identities and Formulas

sin (ωt ± 180°) = -sin ωt

cos (ωt ± 180°) = -cos ωt

sin (ωt ± 90°) = ± cos ωt

cos (ωt ± 90°) = sin ωt

Sum and Difference Formulas

$$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$$

$$\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$$

$$\tan(\alpha \pm \beta) = \frac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha\tan\beta}$$

Product to Sum Formulas

$$\sin\alpha\sin\beta = \frac{1}{2}[\cos(\alpha-\beta) - \cos(\alpha+\beta)]$$

$$\cos\alpha\cos\beta = \frac{1}{2}[\cos(\alpha-\beta) + \cos(\alpha+\beta)]$$

$$\sin\alpha\cos\beta = \frac{1}{2}[\sin(\alpha+\beta) + \sin(\alpha-\beta)]$$

$$\cos\alpha\sin\beta = \frac{1}{2}[\sin(\alpha+\beta) - \sin(\alpha-\beta)]$$

Sum to Product Formulas

$$\sin\alpha + \sin\beta = 2\sin\left(\frac{\alpha+\beta}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right)$$

$$\sin\alpha - \sin\beta = 2\cos\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right)$$

$$\cos\alpha + \cos\beta = 2\cos\left(\frac{\alpha+\beta}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right)$$

$$\cos\alpha - \cos\beta = -2\sin\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right)$$