



UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE : LED12102

SUBJECT TITLE : ELECTRIC CIRCUIT

PROGRAMME NAME : DIPLOMA OF ENGINEERING TECHNOLOGY IN
(FOR MPU: PROGRAMME LEVEL) ELECTRICAL AND ELECTRONICS (MARINE)

TIME / DURATION : 2.00 PM - 4.30 PM
(2 HOURS 30 MINUTES)

DATE : 23 JUNE 2025

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** 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** question in Section A. For Section B, answer **TWO (2)** questions.
 5. Please write your answers on the answer booklet provided.
 6. Answer **ALL** questions in English language **ONLY**.
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THERE ARE 6 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

Section A (Total 60 marks)

Answer ALL Questions

Question 1 (CLO 1)

With reference to basic electronic system, Ohm's Law series and parallel circuit.

- (a) A basic electronic system involves components and elements to produce the output. Determine the function of component resistor, inductor and capacitor in the circuit. (5 marks)
- (b) Describe the characteristics of a series circuit in DC circuit theorem. (5 marks)
- (c) In a ship's navigation light system, there are three resistors with 10Ω , 20Ω , and 30Ω are connected in series. Determine the equivalent resistance for the circuit. (5 marks)
- (d) The vessel's electrical panel involved a simple circuit of resistors, R_1 , R_2 and R_3 are connected in parallel, with the value of 12Ω , 6Ω , and 4Ω , respectively. Produce the total resistance of the circuit that needs to be used for the control panel. (5 marks)

Question 2 (CLO 2)

With reference to DC circuit theorem – Nodal and Mesh Analysis

- (a) Explain Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL) applied in electrical systems onboard ships. (5 marks)
- (b) By using KVL, determine the current, I , flow in the circuit with a given element of power supply $12V$. The resistors involved are $R_1 = 2\Omega$, $R_2 = 4\Omega$ and $R_3 = 6\Omega$, connected in series. Produce your answer in mA. (5 marks)
- (c) Explain the main difference between Nodal and Mesh Analysis in DC circuits. (5 marks)
- (d) Referring to Figure 1, explain the current looping I_1 and I_2 shown in the circuit. (5 marks)

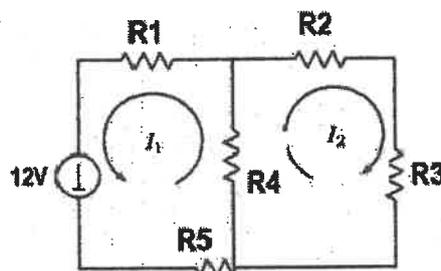


Figure 1

Question 3 (CLO 2)**With reference to DC circuit theorem – Kirchhoff Laws, star delta transformation**

- (a) Define Star-Delta (Y- Δ) transformation that is used in shipboard electrical systems. Illustrate your answers by including an appropriate formula(s). (10 marks)
- (b) A marine engineer is troubleshooting a ship's radar power supply system. Convert the following Delta resistors into equivalent Star configuration. Given the values of resistors are $R_{AB}=6\Omega$, $R_{BC}=9\Omega$ and $R_{CA} = 3\Omega$. (10 marks)

Section B (Total 40 marks)

Answer TWO Questions ONLY.

Question 4 (CLO 2)

With reference to DC circuit theorem – superposition theorem and source transformation

(a) Compare the Superposition Theorem and Source Transformation used by the marine engineers to troubleshoot a complex DC circuit onboard ship. Provide examples to support your answer.

(8 marks)

(b) In superposition theorem, considering a circuit in Figure 2, calculates the value of V_x due to the 16V source.

(6 marks)

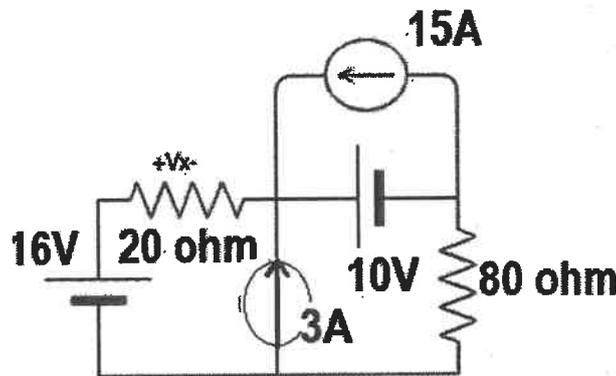


Figure 2

(c) Calculate I_{R2} for the circuit shown in Figure 3, by simplifying the circuit using Source Transformation.

(6 marks)

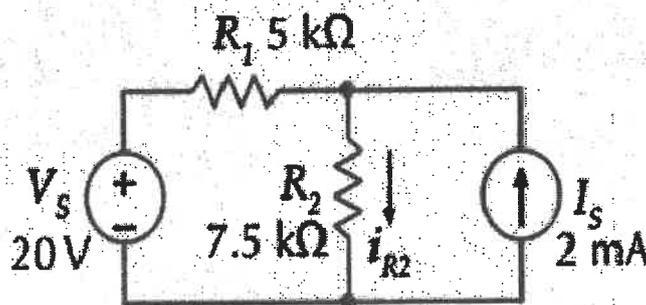


Figure 3

Question 5 (CLO 1)

With reference to Single – Phase AC Circuit RLC with complex power

(a) A single-phase RLC series circuit has the following parameters shown in Table 1.

Table 1.

Resistance, R	20 Ω
Inductor, L	0.2 H
Capacitor, C	100 μ F
Supply voltage, V	240 \angle 0 $^\circ$ V (rms)
Frequency, f	50Hz

- i. Calculate the total impedance, Z. (4 marks)
- ii. Calculate the current, I flow in the circuit. (4 marks)
- iii. Find the complex power, S and express it in the form, $S=P+jQ$ (4 marks)

(b) Assuming a single-phase AC circuit consists of a 100 V rms voltage source connected to a series RLC load. The load consumes 800 W of real power and has a power factor of 0.8 lagging.

- i. Calculate the apparent power S and reactive power Q. (2 marks)
- ii. Determine the magnitude of the current. (2 marks)
- iii. Write the complex power in rectangular form. (4 marks)

Question 6 (CLO 2)

With reference to transmission line parameter (3-phase circuit), transient current in RLC circuits.

- (a) A marine auxilia Three similar coils, each of resistance 7 Ω and inductance 0.03 H are connected in **Delta** across Country A at 415 V, 3-phase supply, as in Figure 4. Note that the generator configuration is symmetrical with the line voltages. Calculate the following: -
- i. The line voltage and its phase voltage (2 marks)
 - ii. The phase current (2 marks)
 - iii. The line current (2 marks)

iv. The power factor

(2 marks)

v. The active, reactive and apparent power taken by each phase of load

(2 marks)

vi. The total active, reactive and apparent power taken by the load.

(3 marks)

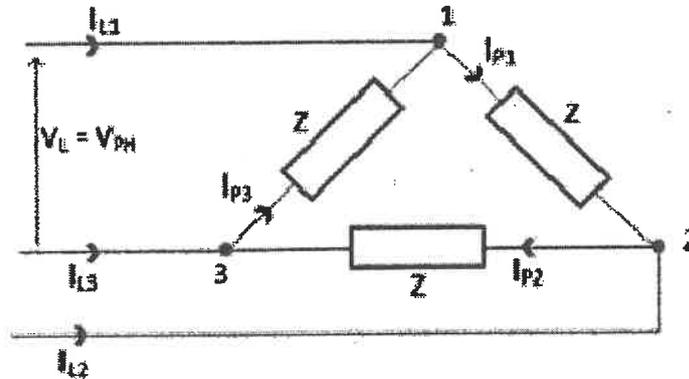


Figure 4.

(b) The circuit shown in Figure 5, has a load being fed by a voltage source through a transmission line. The impedance of the line is represented by $(4+j2) \Omega$ the impedance and a return path. Calculate the real power and reactive power absorbed by:

i. The source,

(2 marks)

ii. The transmission line

(2 marks)

iii. The load for the circuit.

(3 marks)

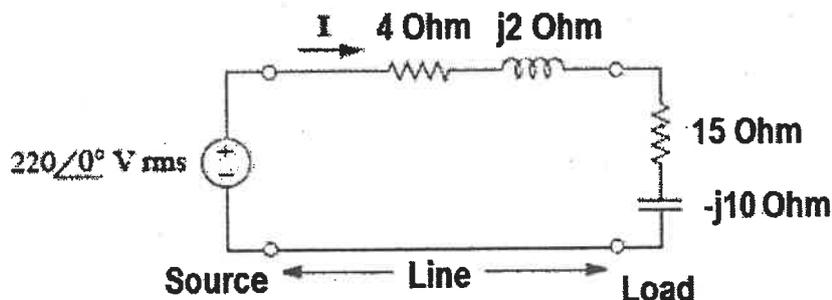


Figure 5.

END OF EXAMINATION PAPER

Formula Sheet

<p>Ohms Law</p> $V = I.R$	<p>General sinusoid</p> $v(t) = V_m \sin(\omega t + \phi)$									
<p>Equivalent Resistance in series.</p> $R_{eq} = R_1 + R_2 + \dots + R_N = \sum_{n=1}^N R_n$	<p>Maximum power dissipated</p> $R_L = R_{TH} \Rightarrow P_{max} = \frac{V_{Th}^2}{4R_L}$									
<p>Voltage Divider</p> $v_n = \frac{R_n}{R_1 + R_2 + \dots + R_N} v$	<p>Power at load</p> $P = i^2 R_L = \left(\frac{V_{Th}}{R_{Th} + R_L} \right)^2 R_L$									
<p>Equivalent Resistance in parallel</p> $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}$	<p>Phasor relationship</p> <table border="1" data-bbox="805 824 1289 1025"> <tr> <td>R</td> <td>$v = Ri$</td> <td>$V = RI$</td> </tr> <tr> <td>L</td> <td>$v = L \frac{di}{dt}$</td> <td>$V = j\omega LI$</td> </tr> <tr> <td>C</td> <td>$i = C \frac{dv}{dt}$</td> <td>$V = \frac{I}{j\omega C}$</td> </tr> </table>	R	$v = Ri$	$V = RI$	L	$v = L \frac{di}{dt}$	$V = j\omega LI$	C	$i = C \frac{dv}{dt}$	$V = \frac{I}{j\omega C}$
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L	$v = L \frac{di}{dt}$	$V = j\omega LI$								
C	$i = C \frac{dv}{dt}$	$V = \frac{I}{j\omega C}$								
<p>Delta to Star</p> $R_1 = \frac{R_b R_c}{(R_a + R_b + R_c)}$ $R_2 = \frac{R_c R_a}{(R_a + R_b + R_c)}$ $R_3 = \frac{R_a R_b}{(R_a + R_b + R_c)}$	<p>Star to Delta</p> $R_a = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1}$ $R_b = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_2}$ $R_c = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_3}$									
<p>Trigo identities</p> $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$ $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$	<p>Sine to Cosine vice versa</p> $\sin(\omega t \pm 180^\circ) = -\sin \omega t$ $\cos(\omega t \pm 180^\circ) = -\cos \omega t$ $\sin(\omega t \pm 90^\circ) = \pm \cos \omega t$ $\cos(\omega t \pm 90^\circ) = \mp \sin \omega t$									
<p>At resonance basic.</p> $X_L = X_C \Rightarrow \omega L = \frac{1}{\omega C}$	<p>At resonance frequency</p> $f_r = \frac{1}{2\pi \sqrt{LC}}$									

<p>Series Resonance</p> $Q = \frac{I^2 X_L}{I^2 R} = \frac{X_L}{R} = \frac{\omega L}{R}$ $Q = \frac{I^2 X_C}{I^2 R} = \frac{X_C}{R} = \frac{\left(\frac{1}{\omega C}\right)}{R} = \frac{1}{\omega CR}$ $Q = \frac{f_r}{BW}$	<p>Parallel resonance</p> $Q = \frac{\left(\frac{V_s^2}{X_L}\right)}{\left(\frac{V_s^2}{R}\right)} = \frac{R}{X_L} = \frac{R}{\omega L}$ $Q = \frac{\left(\frac{V_s^2}{X_C}\right)}{\left(\frac{V_s^2}{R}\right)} = \frac{R}{X_C} = \frac{R}{\left(\frac{1}{\omega C}\right)} = \omega CR$ $Q = \frac{f_r}{BW}$
<p>Bandwidth</p> $BW = f_2 - f_1$	<p>Half-Power (Cut-off) Frequencies</p> $f_1 = f_r - \frac{BW}{2}$ $f_2 = f_r + \frac{BW}{2}$

