



UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE : LED11003

SUBJECT TITLE : ELECTRIC CIRCUITS

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 **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 5 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) Series and parallel circuits are very important in vessels, especially inside control equipment. Explain the applications of series and parallel in simple circuit control for vessel equipment. (5 marks)
- (b) Describe the characteristics of a parallel circuit in DC circuit theorem. (5 marks)
- (c) In a ship's navigation light system, there are three resistors with 20Ω , 40Ω , and 30Ω are connected in series. Determine the total resistance for the circuit. (5 marks)
- (d) The vessel's electrical panel involved a simple circuit of resistors, R1, R2, R3 and R4 are connected in parallel, with the value of 8Ω , 4Ω , 2Ω , and 1Ω , 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) Determine the significance of KVL in shipboard electrical systems. (5 marks)
- (c) Explain the difference between Mesh and Nodal Analysis in DC circuits theorem. (5 marks)
- (d) List the steps involved in performing mesh analysis on a marine control circuit. (5 marks)

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) State the Thevenin's Theorem for DC network. (5 marks)
- (c) Compare the difference between Thevenin's and Norton's Theorem (5 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) For the situation of the voltage source V_1 is 10 V connected in series with R_1 with $2\ \Omega$. The current source I_2 is 2 A is in parallel with R_2 at $4\ \Omega$. While R_3 has $6\ \Omega$ resistor connecting to the two branches. Calculate the current through R_3 using Superposition Theorem.

(10 marks)

(b) A DC circuit has a Thevenin equivalent voltage of 12 V and Thevenin resistance of $4\ \Omega$. Calculate the load resistance to receive maximum power transfer for the circuit.

(5 marks)

(c) If the source voltage is 20 V, $R_{Th}=10\ \Omega$, and the load resistance is $30\ \Omega$, calculate the power delivered to the load and compare it with the maximum power that could be delivered.

(5 marks)

Question 5 (CLO 1)**With reference to Single – Phase AC Circuit RLC with complex power**

(a) For a series RLC circuit with a resistor of $R=10\ \Omega$ an inductor of $L=5\ \text{mH}$, and a capacitor of $C=2\ \mu\text{F}$, calculate the impedance Z at a frequency $f=1\ \text{kHz}$.

(10 marks)

(b) For a parallel RLC circuit with $L=1\ \text{mH}$ and $C=100\ \text{pF}$, calculate the resonant frequency f_0 .

(10 marks)

Question 6 (CLO 2)

With reference to transmission line parameter, transient current in RLC circuits.

- (a) An RLC series circuit with $R=50$, $L=0.1H$, and $C=100 \mu F$ is subjected to a step input of 10 V at $t=0$. Derive the expression for the transient current $i(t)$ and calculate the maximum current in the circuit. (10 marks)
- (b) A ship's VHF radio uses a coaxial cable to connect the antenna. For lossless line,
- i. Derive the formula for characteristic impedance Z . (3 marks)
 - ii. Explain the impact of signal distortion at sea. (3 marks)
 - iii. Discuss the condition for a distortion less line during marine navigation. (4 marks)

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" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">R</td> <td style="text-align: center;">$v = Ri$</td> <td style="text-align: center;">$V = RI$</td> </tr> <tr> <td style="text-align: center;">L</td> <td style="text-align: center;">$v = L \frac{di}{dt}$</td> <td style="text-align: center;">$V = j\omega LI$</td> </tr> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">$i = C \frac{dv}{dt}$</td> <td style="text-align: center;">$V = \frac{I}{j\omega C}$</td> </tr> </table>	R	$v = Ri$	$V = RI$	L	$v = L \frac{di}{dt}$	$V = j\omega LI$	C	$i = C \frac{dv}{dt}$	$V = \frac{I}{j\omega C}$
R	$v = Ri$	$V = RI$								
L	$v = L \frac{di}{dt}$	$V = j\omega LI$								
C	$i = C \frac{dv}{dt}$	$V = \frac{I}{j\omega C}$								
<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> $f_1 = f_r - \frac{BW}{2}$ $f_2 = f_r + \frac{BW}{2}$

