

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: BMT 1013
COURSE	: CIRCUIT THEORY
SEMESTER/SESSION	: 2-2024/2025
DURATION	: 3 HOURS

**Instructions:**

1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

**DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO**

**THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE**

**QUESTION 1**

a) Describe the concept of the following terms:

- i. Superposition Theorem. (4 marks)
- ii. Source Transformation. (4 marks)

b) Determine the voltage across  $R_2$ ,  $V_{R2}$  for the circuit in Figure 1 by using superposition theorem. (7 marks)

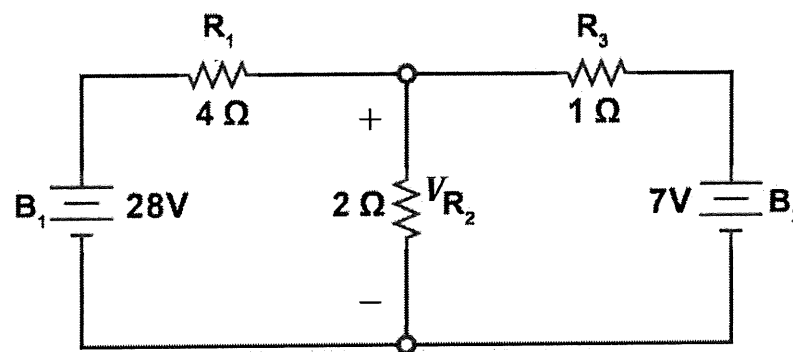


Figure 1

c) Referring to the circuit in Figure 2,

- i. Explain the steps to apply Source Transformation in a circuit. (6 marks)
- ii. Analyze the voltage across resistor,  $V_0$ . (8 marks)

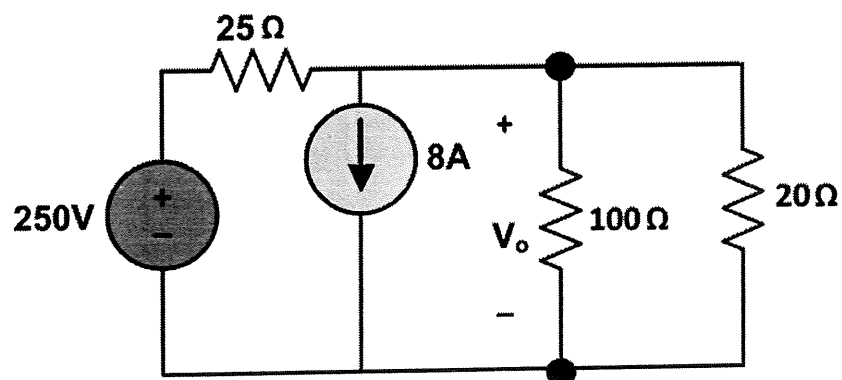
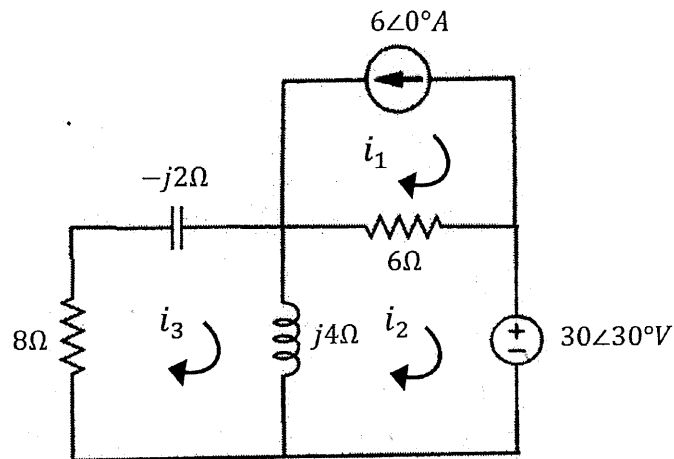


Figure 2

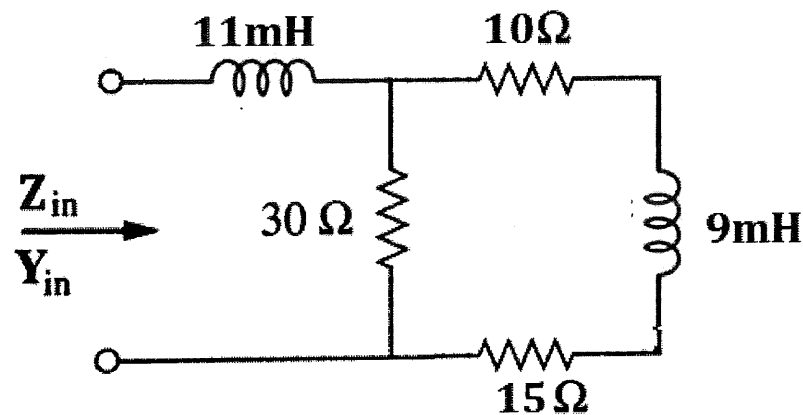
**QUESTION 2**

- a) Describe the steps to analyze alternating current (AC) circuits. (3 marks)
- b) Given a sinusoid  $v(t) = 32 \sin(100t) \text{ V}$ , identify its phasor domain. (3 marks)
- c) Referring to the circuit in Figure 3,
- Describe the steps to find current,  $i_3$  by applying mesh analysis. (8 marks)
  - Analyze the current,  $i_3$  by using mesh analysis. (15 marks)

**Figure 3**

**QUESTION 3**

- a) State two (2) phasor relationship of voltage and current for each following terms,
- i. Resistor,  $R$ . (2 marks)
  - ii. Capacitor,  $C$ . (2 marks)
  - iii. Inductor,  $L$ . (2 marks)
- b) Referring to the circuit in Figure 4,
- i. Determine the input impedance,  $Z_{in}$  at  $\omega = 10 \text{ rad/s}$ . (10 marks)
  - ii. Determine the input admittance  $Y_{in}$ . (2 marks)

**Figure 4**

c) For the circuit in Figure 5, analyze:

i. Voltage,  $v(t)$ .

(4 marks)

ii. Current,  $i(t)$ .

(6 marks)

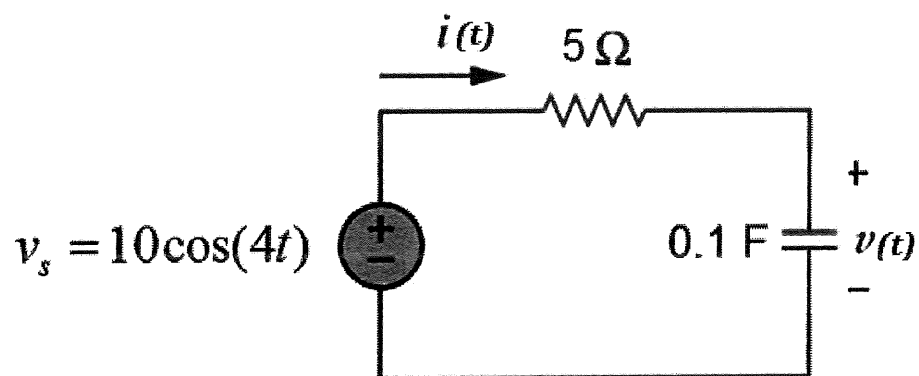


Figure 5

**QUESTION 4**

a) Answer the following questions:

- i. Describe the series and parallel resonance circuit. (4 marks)
- ii. Illustrate the series and parallel resonance circuit. (4 marks)

b) Referring to the circuit in Figure 6, calculate:

- i. The resonant frequency,  $f_r$ . (1 mark)
- ii. The quality factor,  $Q$ . (2 marks)
- iii. The bandwidth,  $BW$ . (1 mark)
- iv. The upper  $-3dB$  frequency points,  $f_H$ . (1 mark)
- v. The lower  $-3dB$  frequency points,  $f_L$ . (1 mark)

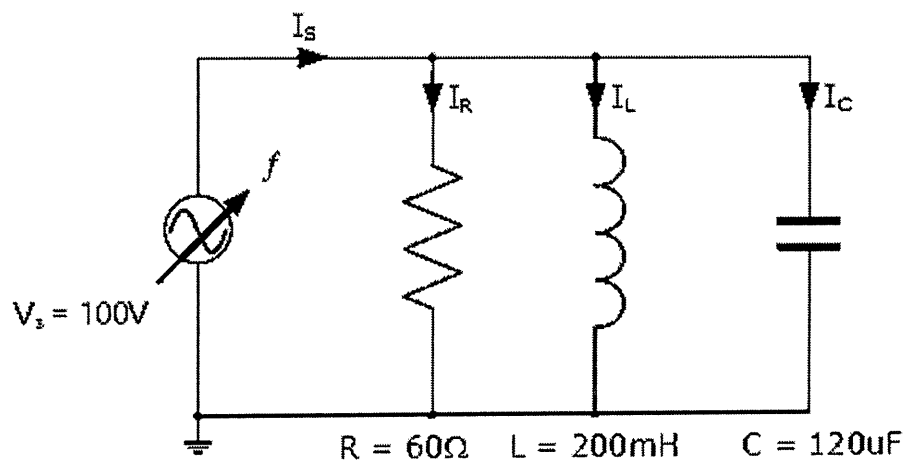


Figure 6

-----End of question-----

## CIRCUIT THEORY (BMT 1013)

## TABLE OF FORMULAS

AC Circuit				
$v(t) = V_m \cos(\omega t + \varphi)$		$V = V_m \angle \varphi$	$Z = R$	$V = IR$
$i(t) = I_m \cos(\omega t + \varphi)$		$I = I_m \angle \varphi$	$Z = \frac{1}{j\omega C}$	$V = \frac{I}{j\omega C}$
$\omega = 2\pi f$	$z = x + jy$	$z = r \angle \varphi$	$Z = j\omega L$	$V = j\omega LI$
$-\sin(A) = \cos(A + 90^\circ)$		$\sin(A) = \cos(A - 90^\circ)$		$Y = \frac{1}{Z_{in}}$
$-r \angle \varphi = r \cos(\omega t + \phi \pm 180)$				
Resonant Circuit				
$f_r = \frac{1}{2\pi\sqrt{LC}}$	$V_L = V_C$	$X_L = X_C$	$X_L = 2\pi fL$	$X_C = \frac{1}{2\pi fC}$
$BW = \frac{f_r}{Q}$	$f_H = f_r + \frac{1}{2}BW$		$f_L = f_r - \frac{1}{2}BW$	
Series	$I_m = \frac{V}{R}$	$Q = \frac{X_L}{R}$	$Q = \frac{X_C}{R}$	
Parallel	$I_T = \frac{V}{R}$	$Q = \frac{R}{X_L}$	$Q = \frac{R}{X_C}$	$I_{MAG} = Q \times I_T$

