UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: BET 1013
COURSE	: CIRCUIT THEORY
SEMESTER/SESSION	: 1-2023/2024
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) Answer the following question:

i. Describe the concept of electrical shock. (3 marks)

ii. Describe **four (4)** laboratory safety rules for students. (4 marks)

b) Figure 1 shows a resistor with four bands. The color code for each band is given in Table 1. Identify:

i. The resistance value. (1 mark)

ii. The percent of tolerance. (1 mark)

iii. The maximum value the resistor can tolerate. (2 marks)

iv. The minimum value the resistor can tolerate. (1 mark)

v. The condition of a resistor when the power rating is less than maximum power in a circuit. (2 marks)

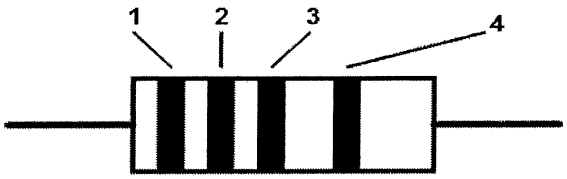

Figure 1

Table 1

Band	Color
1	Green
2	Blue
3	Violet
4	Silver

c) Determine the total capacitance, C_T of the circuit in Figure 2. Show all calculation.

(7 marks)

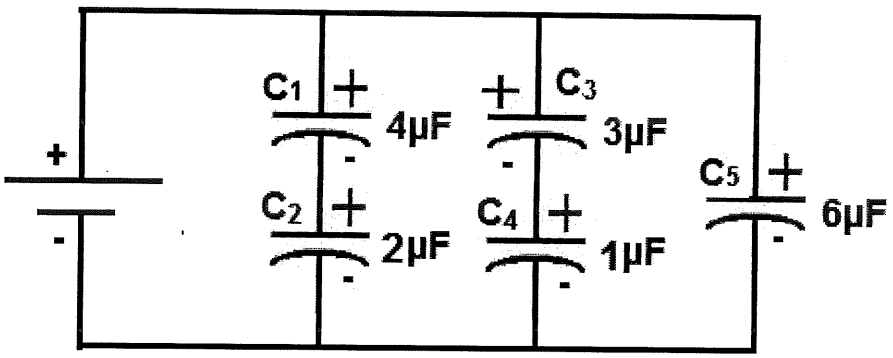

Figure 2

d) Analyze the circuit in Figure 3 under DC condition:

i. The current, i_L. (4 marks)

ii. The energy stored in inductor, W_L. (3 marks)

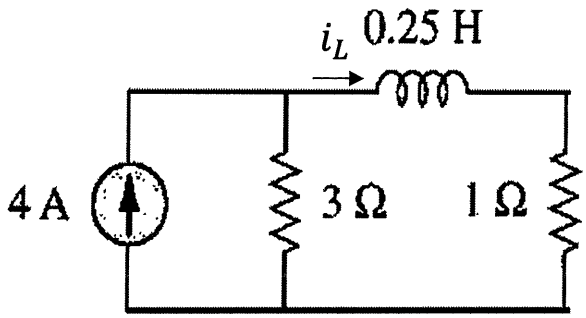

Figure 3

QUESTION 2

a) Answer the following questions:

i. Describe the concept of source transformation. (4 marks)

ii. Analyze current, I at resistor, R_3 in Figure 4 by using source transformation. (11 marks)

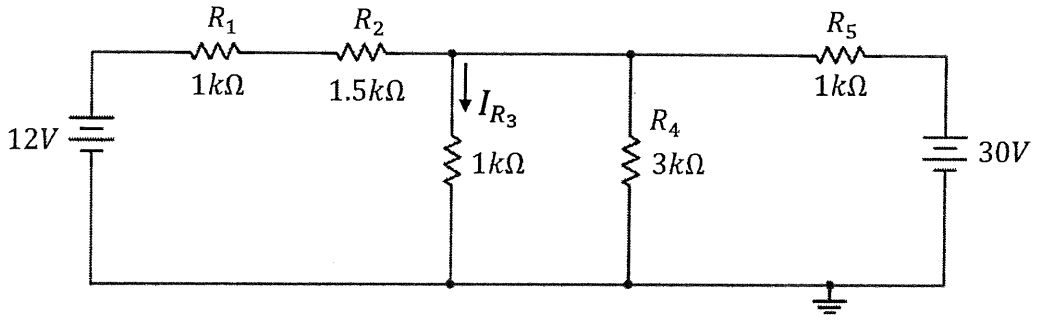

Figure 4

b) Referring to the circuit in Figure 5:

i. State the voltage value at reference node. (1 mark)

ii. State the Ohm's Law that used in nodal analysis. (1 mark)

iii. Without any calculation, describe the expected current through resistor 8Ω and 10Ω. Give the reason. (2 marks)

iv. Analyze the circuit to obtain voltage V_1 and V_2 using nodal analysis. (10 marks)

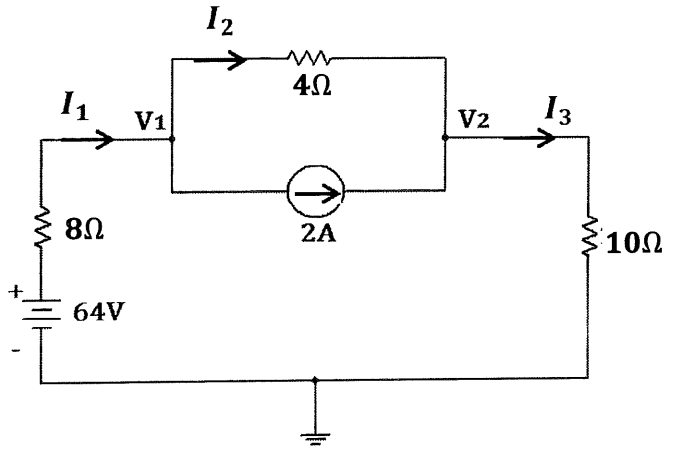

Figure 5

QUESTION 3

a) Given a sinusoid,

$$v(t) = 28 \sin\ (100t + 10\,°)v$$

Identify for each:

i. Amplitude, v_m (1 mark)

ii. Phase, $\emptyset$ (1 mark)

iii. Angular frequency, ω (1 mark)

iv. Frequency, f (1 mark)

v. Period, T (1 mark)

vi. Phasor, V (2 marks)

b) A series-connected load draws a current $i(t) = 6\cos(100\pi t + 10°)$ A when the applied voltage is $v(t) = 150\cos(100\pi t - 20°)$ V. Answer the following question:

i. Calculate the apparent power,S of the load. (4 marks)

ii. Calculate the power factor, pf of the load. (2 marks)

iii. Describe the power factor based on your answer in b) (ii). (2 marks)

c) Determine the input impedance, Z_{in} of the circuit in Figure 6 at $\omega = 10\,rad/s$.

(7 marks)

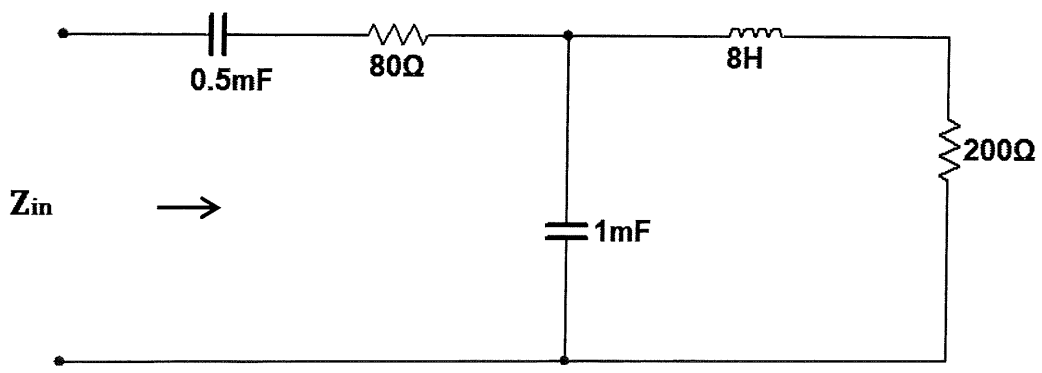

Figure 6

QUESTION 4

a) Describe the following terms:

i. Electric power transmission. (3 marks)

ii. Electric power distribution. (3 marks)

b) Answer the following questions:

i. Differentiate **two (2)** comparison of series and parallel resonance. (4 marks)

ii. Describe **three (3)** parameter of resonance circuit. (3 marks)

c) A Y-connected supplies is connected to Y-connected loads as shown in Figure 7. Determine impedance and current in the given three phase system.

i. Impedance, Z_Y (2 marks)

ii. Current, I_a (2 marks)

iii. Current, I_b (2 marks)

iv. Current, I_c (2 marks)

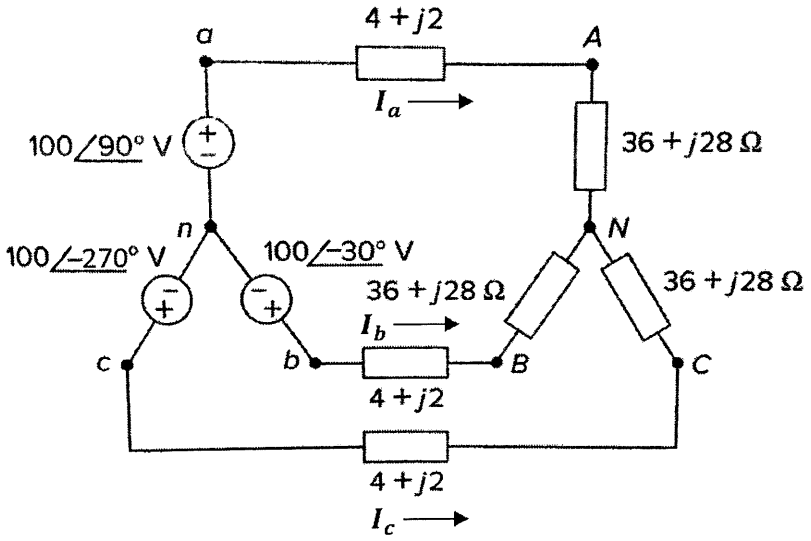

Figure 7

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

TABLE OF FORMULAS

<table>
<tr><th colspan="5">AC Circuit</th></tr>
<tr><td colspan="2">$v(t) = V_m \cos(\omega t + \varphi)$</td><td>$V = V_m \angle \varphi$</td><td>$Z = R$</td><td>$V = IR$</td></tr>
<tr><td colspan="2">$i(t) = I_m \cos(\omega t + \varphi)$</td><td>$I = I_m \angle \varphi$</td><td>$Z = \frac{1}{j\omega C}$</td><td>$V = \frac{I}{j\omega C}$</td></tr>
<tr><td>$z = x + jy$</td><td>$\omega = 2\pi f$</td><td>$z = r \angle \varphi$</td><td>$Z = j\omega L$</td><td>$V = j\omega LI$</td></tr>
<tr><td colspan="2">$-sin(A) = cos(A + 90°)$</td><td colspan="2">$sin(A) = cos(A - 90°)$</td><td>$Y = \frac{1}{Z_{in}}$</td></tr>
<tr><td colspan="2">$S = V_{rms} I_{rms}$</td><td colspan="3">$pf = \frac{P}{S} = cos(\theta_v - \theta_i)$</td></tr>
<tr><td colspan="5">$-\mathrm{r} \angle \varphi = r \cos(\omega t + \emptyset \pm 180)$</td></tr>
<tr><th colspan="5">Three Phase Circuit</th></tr>
<tr><td>Y – Y Connection</td><td colspan="2">$I_a = \frac{V_{an}}{Z_Y}$
$I_b = \frac{V_{bn}}{Z_Y}$
$I_c = \frac{V_{cn}}{Z_Y}$</td><td colspan="2">$V_{an} = V_P \angle 0°V$
$V_{bn} = V_P \angle -120°V$
$V_{cn} = V_P \angle -240°V$
$Z_1 = Z_2 = Z_3 = Z_Y$</td></tr>
<tr><td>Δ – Δ Connection</td><td colspan="2">$I_{AB} = \frac{V_{ab}}{Z_\Delta}$
$I_{BC} = \frac{V_{bc}}{Z_\Delta}$
$I_{CA} = \frac{V_{ca}}{Z_\Delta}$
$I_a = I_{AB} - I_{CA}$
$I_b = I_{BC} - I_{AB}$
$I_c = I_{CA} - I_{BC}$</td><td colspan="2">$V_{ab} = V_P \angle 0°V$
$V_{bc} = V_P \angle -120°V$
$V_{ca} = V_P \angle -240°V$
$Z_a = Z_b = Z_c = Z_\Delta$</td></tr>
</table>