



## UNIVERSITY COLLEGE TATI (UC TATI)

## FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DEI 1003 / DMT 1113
COURSE	: ELECTRICAL TECHNOLOGY
SEMESTER/SESSION	: 2-2022/2023
DURATION	: 3 HOURS

Instructions:

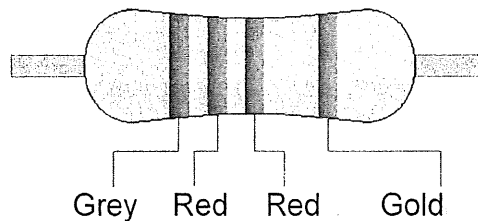
1. This booklet contains 4 questions. Answer **ALL** the questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

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

**THIS BOOKLET CONTAINS 11 PRINTED PAGES INCLUDING COVER PAGE**

**QUESTION 1**

- a) Define the following questions:
- i. Charge. (1 mark)
  - ii. Current. (1 mark)
  - iii. Voltage. (1 mark)
- b) Express the following numbers in **engineering notation** and **metric prefix** form.  
0.0000000345 (2 marks)
- c) Determine the current value if 15 coulomb of charge pass through a wire for 3 seconds. (2 marks)
- d) State the color bands for a  $33 \text{ k}\Omega \pm 10\%$  resistor. (2 marks)
- e) Figure 1 shows a 4 bands resistor.

**Figure 1**

- i. State the resistance values and tolerance for the following 4-band resistor. (2 marks)
- ii. Determine the minimum and the maximum resistance within the tolerance limits for the resistor in e) i. (3 marks)

f) For the circuit in Figure 2, determine:

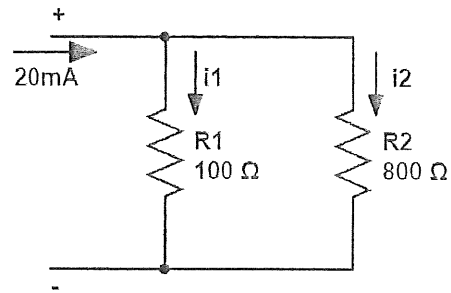
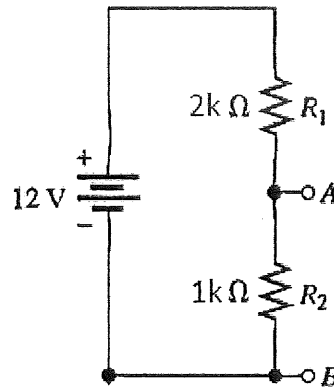


Figure 2

- i. Current  $I_1$ . (3 marks)
- ii. Current  $I_2$ . (3 marks)
- iii. Voltage drop across  $R_1$ . (3 marks)
- iv. Voltage drop across  $R_2$ . (2 marks)

**QUESTION 2**

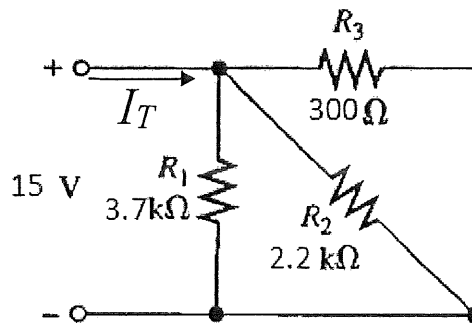
- a) For the voltage divider circuit shown in Figure 3, find the **voltage** between points **A** and **B**.



**Figure 3**

(4 marks)

- b) For the circuit in Figure 4;



**Figure 4**

- i. Compute total resistance, R<sub>T</sub> of the circuit. (3 marks)
  - ii. Determine total current, I<sub>T</sub>. (3 marks)
- c) State three (3) physical characteristics that affect the capacitance of a capacitor. (3 marks)

d) Figure 5 shows a parallel connection of capacitors.

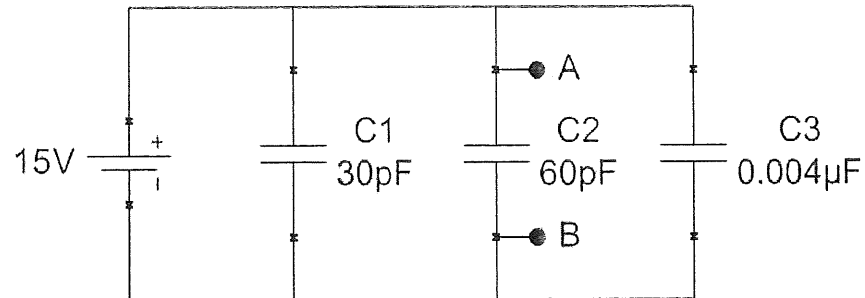


Figure 5

- i. Determine the **total capacitance**,  $C_T$  for the circuit. (3 marks)
- ii. Determine the voltage across point A and B. (1 mark)

e) Determine the amount of **energy** stored in a 5.7 mH inductor when the current is 10 mA. (2 marks)

f) A student wraps 300 turns of wire on a pencil that is 8mm in a diameter as shown in Figure 6. The pencil has the same permeability as a vacuum ( $4\pi \times 10^{-6}$  H/m). Find the inductance, L of the coil that is formed.

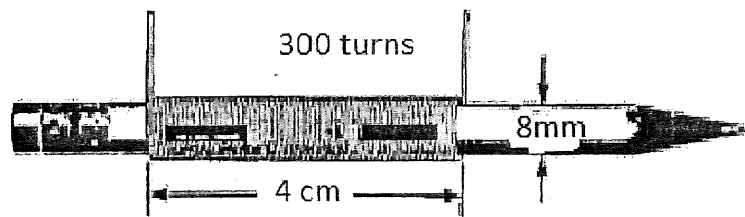
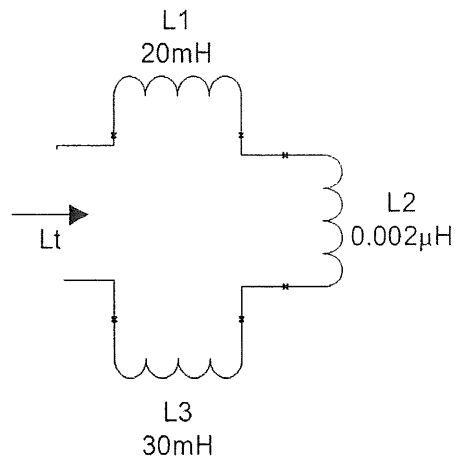


Figure 6

(3 marks)

- g) Compute the total inductance,  $L_T$  for Figure 7.



**Figure 7**

(2 marks)

## QUESTION 3

- a) For the sine wave in Figure 8, determine the;

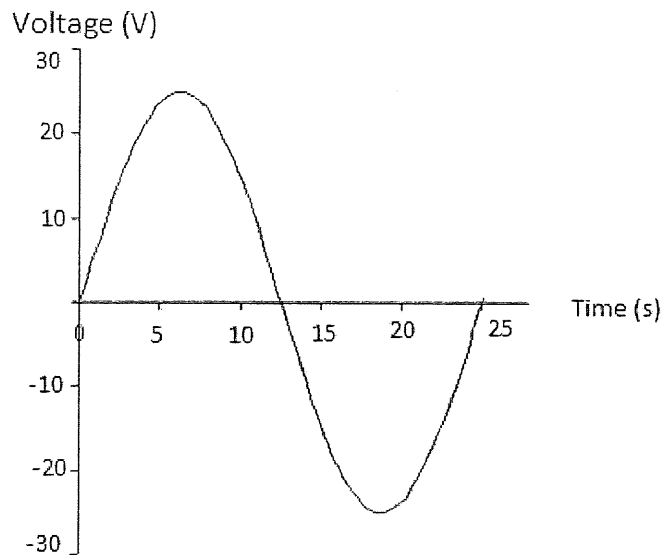


Figure 8

- i. Frequency,  $f$  (3 marks)
  - ii. Peak voltage,  $V_p$  (2 marks)
  - iii. rms voltage,  $V_{rms}$  (3 marks)
- b) A sine voltage is applied to the resistive circuit in Figure 9. Determine the;

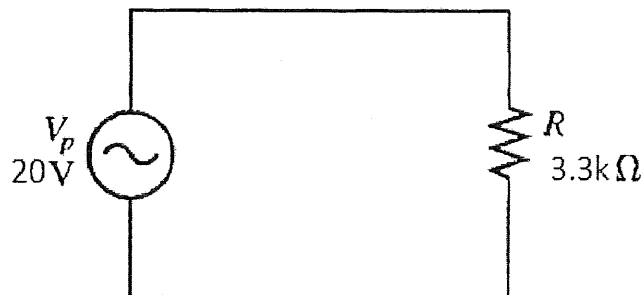


Figure 9

- i. Peak current,  $I_{peak}$  (2 marks)
- ii. rms current,  $I_{rms}$  (2 marks)
- iii. Average current,  $I_{average}$  (2 marks)

- d) A wye-connected three-phase alternator supplies power to a delta-connected resistive load as in Figure 12. The alternator has a line voltage of 415 V. Each resistor of the delta load has  $10\ \Omega$  of resistance. Determine the following values;

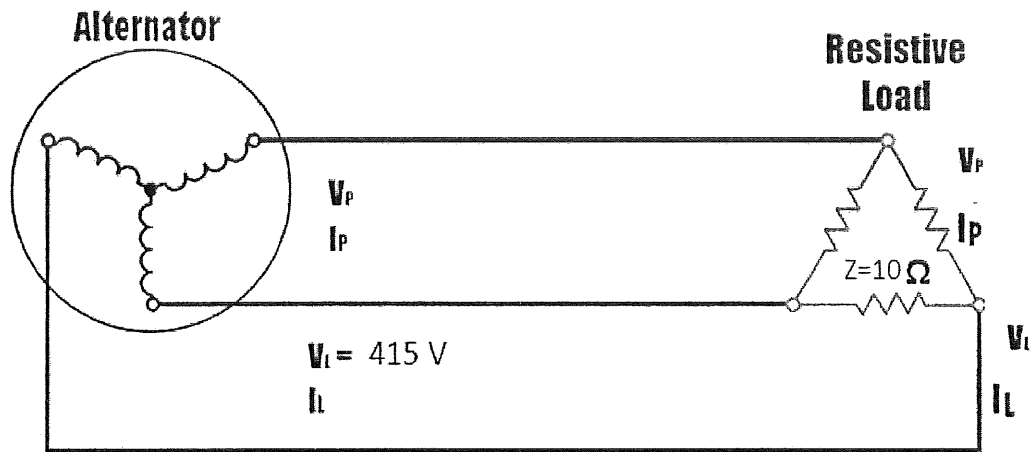


Figure 12

- Phase voltage of the alternator,  $V_{\text{PHASE(Alt)}}$  (3 marks)
- Line voltage of the load,  $V_{\text{LINE(Load)}}$  (1 mark)
- Phase current of the load,  $I_{\text{PHASE(Load)}}$  (3 marks)
- Line current of the load,  $I_{\text{LINE(Load)}}$  (3 marks)

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

## QUESTION 3

- a) For the sine wave in Figure 8, determine the;

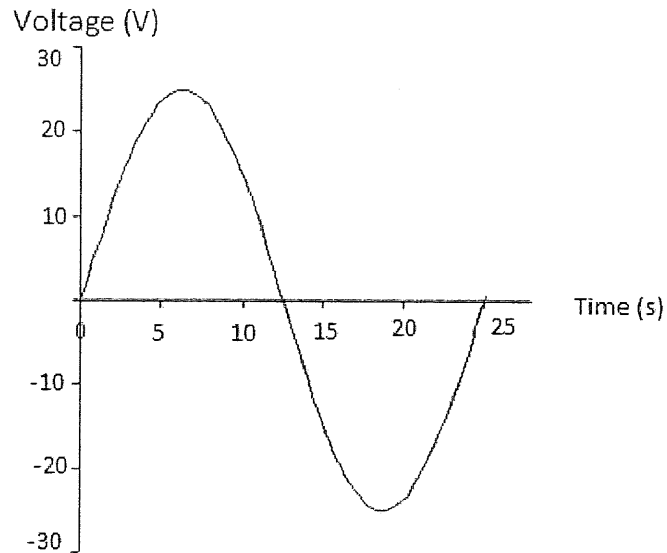


Figure 8

- i. Frequency,  $f$  (3 marks)
- ii. Peak voltage,  $V_p$  (2 marks)
- iii. rms voltage,  $V_{rms}$  (3 marks)

- b) A sine voltage is applied to the resistive circuit in Figure 9. Determine the;

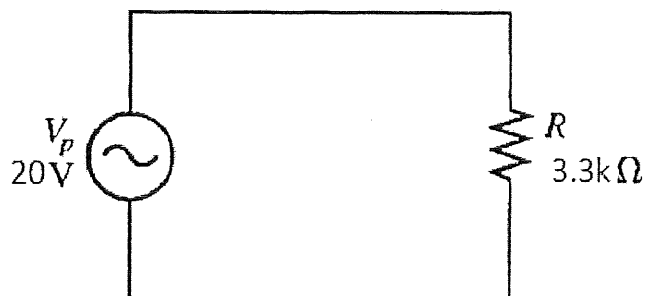


Figure 9

- i. Peak current,  $I_{peak}$  (2 marks)
- ii. rms current,  $I_{rms}$  (2 marks)
- iii. Average current,  $I_{average}$  (2 marks)

- c) Determine the flux density in a rectangular core that is 5.0 mm by 15.0 mm if the flux is 20 mWb. (3 marks)
- d) At a given location, assume the earth's magnetic is 0.35 gauss. Express this flux density in unit of tesla (T). (3 marks)
- e) Calculate the reluctance ( $\mathcal{R}$ ) of a material with a length of 0.2 m and a cross-sectional area of 0.06 m<sup>2</sup> if the absolute permeability is  $50 \times 10^{-7}$  Wb/At.m. (3 marks)
- f) Find the magnetomotive force (mmf) in a 40 turn coil of wire when there are 2.5 A of current through it. (3 marks)
- g) Given a magnetic device as shown in Figure 10.

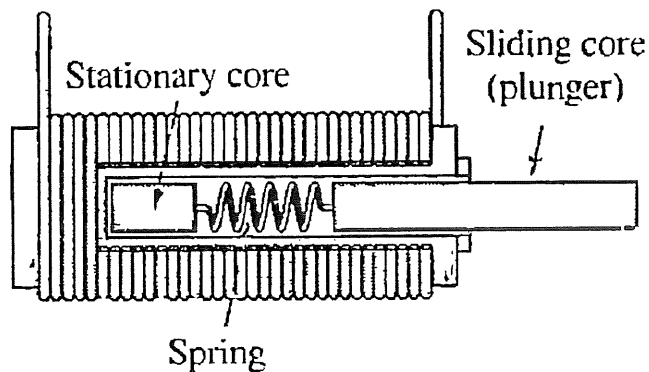
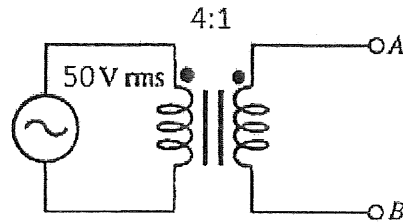


Figure 10

- i. Name the device. (1 mark)
- ii. Give **ONE (1)** application which uses the device in g) i. (1 mark)
- iii. Give another **ONE (1)** device that used the same principle as the device in Figure 10. (1 mark)

**QUESTION 4**

- a) For the transformer in Figure 11;



**Figure 11**

- i. Determine the rms value in secondary voltage,  $V_{rms(sec)}$ . (2 marks)
  - ii. Calculate the peak voltage at secondary,  $V_{p(sec)}$ . (3 marks)
- b) Determine the current output by the secondary winding of a transformer if the primary current is 3 A, the secondary winding has 1000 turns, and the primary winding has 200 turns. (3 marks)
- c) There are two types of three phase connection. Draw that **TWO (2)** forms of the connection. (4 marks)

- d) A wye-connected three-phase alternator supplies power to a delta-connected resistive load as in Figure 12. The alternator has a line voltage of 415 V. Each resistor of the delta load has  $10\ \Omega$  of resistance. Determine the following values;

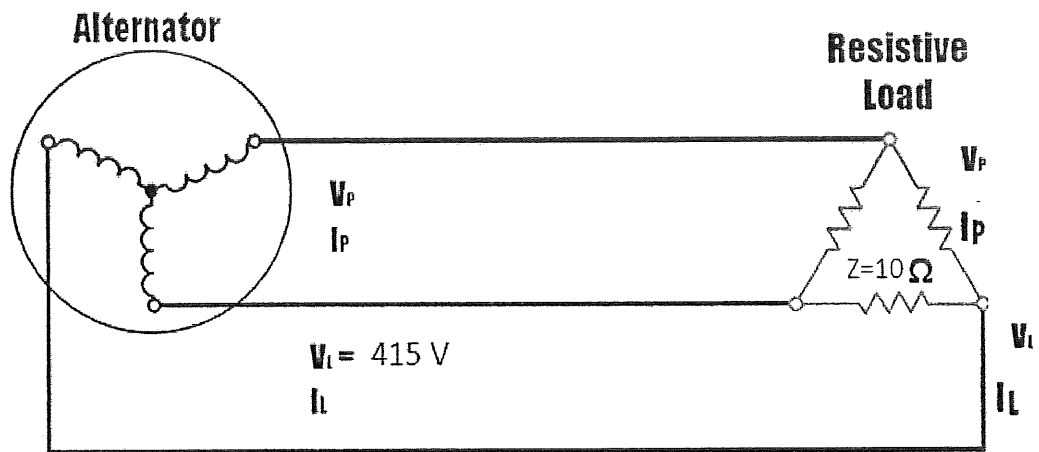


Figure 12

- Phase voltage of the alternator,  $V_{\text{PHASE(Alt)}}$  (3 marks)
- Line voltage of the load,  $V_{\text{LINE(Load)}}$  (1 mark)
- Phase current of the load,  $I_{\text{PHASE(Load)}}$  (3 marks)
- Line current of the load,  $I_{\text{LINE(Load)}}$  (3 marks)

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

## APPENDIX

1.  $V_x = \left(\frac{R_x}{R_T}\right) V_S$

2.  $I_x = \left(\frac{R_T}{R_x}\right) I_T$

3.  $W = \frac{1}{2}LI^2$

4.  $L = \frac{N^2\mu A}{l}$

5.  $V_{\text{rms}} = 0.707V_p$

6.  $V_{\text{avg}} = 0.637V_p$

7.  $v = V_p \sin \theta$

8.  $v = V_p \sin (\theta \pm \phi)$

9.  $v = V_p \sin 2 \pi ft$

10.  $B = \frac{\phi}{A}$

11.  $\mu_r = \frac{\mu}{\mu_0}$

12.  $\mathcal{R} = \frac{l}{\mu A}$

13.  $F_m = NI$

14.  $\phi = \frac{F_m}{\mathcal{R}}$

15.  $n = \frac{N_{\text{sec}}}{N_{\text{pri}}} = \frac{V_{\text{sec}}}{V_{\text{pri}}} = \frac{I_{\text{pri}}}{I_{\text{sec}}}$

16.  $L_M = k\sqrt{(L_1L_2)}$

17.  $k = \frac{\phi_{1-2}}{\phi_1}$

18.  $A = \pi r^2$

19.  $\eta = \left(\frac{P_{\text{out}}}{P_{\text{in}}}\right) 100\%$

20. Wye

$$V_\phi = \frac{V_L}{1.732}$$

21. Delta

$$I_\phi = \frac{I_L}{1.732}$$

22.  $VA = 3 \times V_\phi \times I_\phi$

