

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

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| COURSE CODE | : BMT 1033 |
| COURSE | : ELECTRICAL TECHNOLOGY |
| SEMESTER/SESSION | : 1-2024/2025 |
| DURATION | : 3 HOURS |

Instructions:

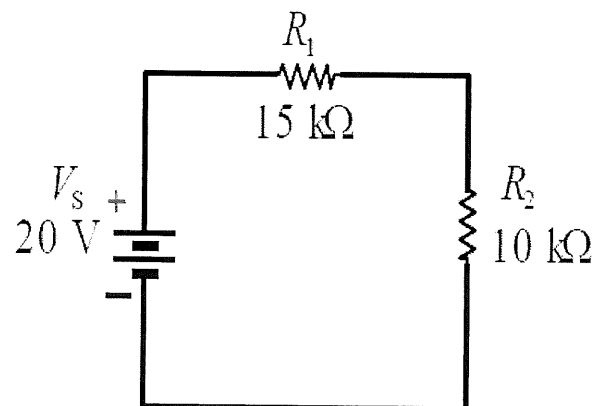
1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise up your hands and ask the invigilator.

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

THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

- a) State the definition for Ohm's Law. (3 marks)
- b) Describe the following basic circuit concepts related to the extreme values of resistance R (i.e. $R = 0$ & $R = \infty$)
- Short circuit. (2 marks)
 - Open circuit. (2 marks)
- c) Draw the circuit diagram of a 3V DC battery, resistor $R_1 = 10\Omega$, and resistor $R_2 = 50\Omega$ all connected in parallel. Label accordingly. (3 marks)
- d) Find the current flowing through a 100Ω resistor having a voltage drop of 5 V DC. Show all workings. (3 marks)
- e) Figure 1 shows a 20V DC supply connected to a $15\text{ k}\Omega$ resistor and a $10\text{ k}\Omega$ resistor.
- Name the connection of the resistors. (1 mark)
 - Find the total current flowing in the circuit. (3 marks)
 - Find the voltage developed across R_2 using Voltage Divider Law. (3 marks)

**Figure 1**

QUESTION 2

- a) Given a sinusoidal of $v(t) = 10 \cos(20t + 50^\circ)V$. Find the following:
- i. Amplitude, $V(m)$. (1 mark)
 - ii. Phase, ϕ . (1 mark)
 - iii. Angular Frequency, ω . (1 mark)
 - iv. Period, T . (2 marks)
- b) Find the polar form of the rectangular form $Z = 2 + j3$. Show all workings. (3 marks)
- c) Find the rectangular form of the polar form $4.47 \angle 63.43^\circ$. Show all workings. (3 marks)
- d) Write down the time domain expression for voltage-current relationship of the inductor. (1 mark)
- e) Find the impedance of a 10 μF capacitor given $\omega = 30 \text{ Hz}$. Show all workings. (3 marks)
- f) Explain the Right Hand Thumb Rule for electromagnetism. (3 marks)

QUESTION 3

- a) Find the magnetic flux density in a rectangular core that is 5.0 mm by 5.0 mm if the magnetic flux is $10 \mu\text{Wb}$. Show all workings. (3 marks)
- b) State the name of the device used to measure magnetic flux density. (1 mark)
- c) Find the reluctance of a material with a length of 0.05m, a cross-sectional area of 0.012 m^2 and a permeability of $3500 \mu\text{Wb/At.m}$. Show all workings. (3 marks)
- d) Find the magnetomotive force (mmf) if a 300 turns coil has 5A of current. Show all workings. (3 marks)
- e) Describe hysteresis loss. (2 marks)
- f) State the name of **two (2)** possible three-phase wiring connections. (2 marks)
- g) Figure 2 shows a three-phase supply connected to a three-phase load. Showing all workings, find;
- The line current I_a . (3 marks)
 - The phase voltage V_{AN} . (3 marks)

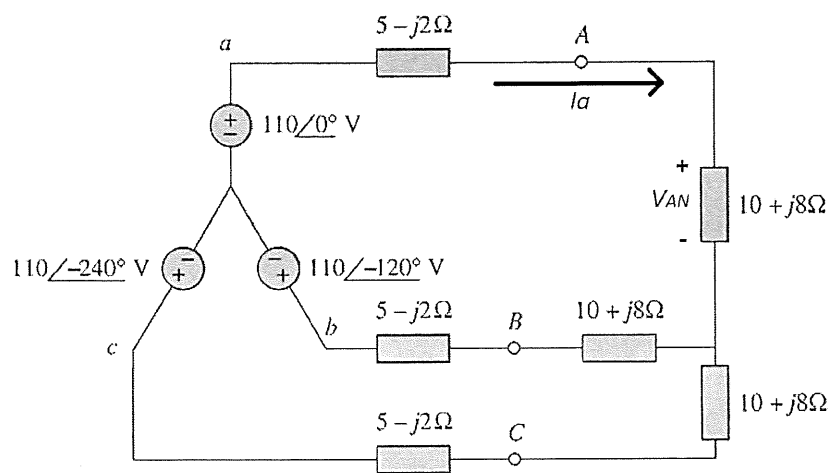


Figure 2

QUESTION 4

- a) A three-phase alternator supplies power to a three-phase resistive load in Figure 3 below. The alternator has a line voltage of 220 V. Each resistor of the load has 10 Ω of resistance. Showing all workings, find;
- i. Line voltage of the load, $E_{L(\text{Load})}$ (2 marks)
 - ii. Phase voltage of the load, $E_{P(\text{Load})}$ (2 marks)
 - iii. Phase current of the load, $I_{P(\text{Load})}$ (3 marks)

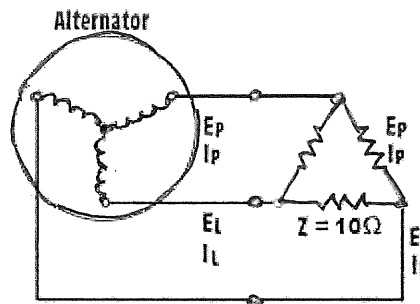


Figure 3

- b) State the type of transformer with a turn ratio of 1. (1 mark)
- c) A transformer with turns ratio of 5 has 5000 turns on the secondary windings.
 - i. State the transformer type. (1 mark)
 - ii. Find the number of turns on the transformer's primary windings. (3 marks)
- d) Based on the transformer circuit as shown in Figure 4.
 - i. State the transformer type. (1 mark)
 - ii. Find the transformer turn ratio. (3 marks)
 - iii. Find the power of primary winding. (3 marks)
 - iv. Find the efficiency of the transformer. (3 marks)

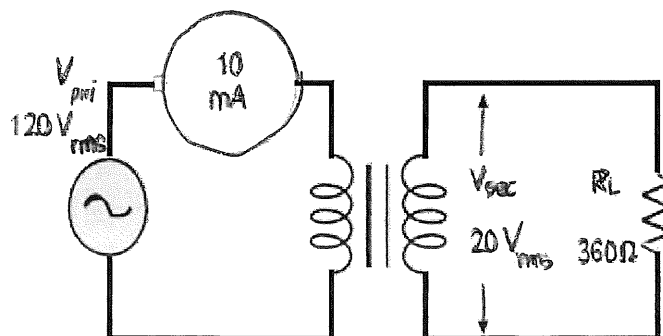


Figure 4

-----End of Question-----

APPENDIX 1

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|-----|----------------------------|---|
| 1. | Ohm's Law | $V = IR$ |
| 2. | Power | $P = VI$ |
| 3. | Series Capacitor | $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots + \frac{1}{C_N}$ |
| 4. | Parallel Capacitor | $C_{eq} = C_1 + C_2 + \dots + C_N$ |
| 5. | Voltage Divider | $V_x = \frac{R_x}{R_T} V_S$ |
| 6. | Current Divider | $I_x = \frac{R_T}{R_x} I_T$ Where $R_T = R_1 R_2 \dots R_n$ |
| 7. | Energy stored in capacitor | $W = \frac{1}{2} CV^2$ |
| 8. | AC Circuit | $T = \frac{2\pi}{\omega}$ $Z = R + j(X_L - X_C)$ $X_C = \frac{1}{j\omega C}$ $X_L = j\omega L$ |
| 9. | Flux Density | $B = \frac{\Phi}{A}$ |
| 10. | Magnetomotive force | $F_m = \phi R$ $F_m = NI$ |
| 11. | Y Connection | $I_{Line} = I_{Phase}$ $E_{Line} = \sqrt{3} E_{Phase}$ |
| 12. | Δ Connection | $I_{Line} = \sqrt{3} I_{Phase}$ $E_{Line} = E_{Phase}$ |
| 13. | Transformer turn ratio | $n = \frac{N_{sec}}{N_{pri}} = \frac{V_{sec}}{V_{pri}} = \frac{I_{pri}}{I_{sec}}$ |
| 14. | Transformer efficiency | $n = \frac{P_{out}}{P_{in}} \times 100$ @ $n = \frac{V_L^2 / R_L}{V_{pri} \times I_{pri}} \times 100$ |