

UNIVERSITY OF GREATER MANCHESTER

**SCHOOL OF ENGINEERING AND BUILT
ENVIRONMENT**

**BENG (HONS) ELECTRICAL AND ELECTRONICS
ENGINEERING**

SEMESTER ONE EXAMINATION 2025/2026

INTRODUCTORY ELECTRICAL PRINCIPLES

MODULE NO: EEE4012

Date: Thursday 15th January 2026

Time: 10am – 12 noon

INSTRUCTIONS TO CANDIDATES:

There are 5 questions.

Answer any 4 questions.

All questions carry equal marks.

Marks for parts of questions are shown in brackets.

This examination paper carries a total of 100 marks.

Formulae sheet is attached at the end of the paper.

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

Question 1

- a) A coil of aluminium wire has a resistance of 50Ω , when its temperature is 0°C . Determine its resistance at 100°C if the temperature coefficient of resistance (TCR) of aluminium at 0°C is $0.0038/^\circ\text{C}$.

[3 marks]

- b) In the circuit given in figure Q1b below, use appropriate network conversion (Δ to Y/Y to Δ) to find the total resistance between points "a" and "b".

[10 marks]

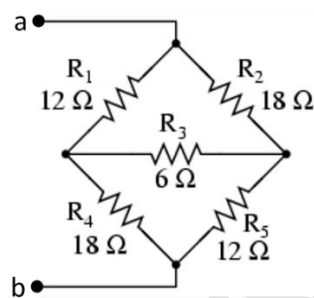


Fig.Q1b

- c) Find the Thevenin equivalent of the circuit given in Figure Q1c below.

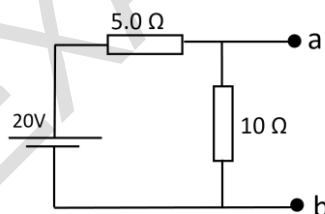


Fig.Q1c

[5 marks]

- d) A stepper motor has an angular resolution of 9 degrees per step. If the clock input producing the stepper motor drive sequence is 250Hz, what will be the rotational speed of the stepper motor in revolutions per minute?

[7 marks]

[Total 25 marks]

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Question 2

a) Define the following terms (1.5 marks for each definition):

- i. Frequency
- ii. Period
- iii. Phase angle
- iv. Peak to peak value
- v. RMS value
- vi. Internal resistance
- vii. Inductance
- viii. Capacitance

[12 marks]

b) A technician is tasked with designing a transformer to match a $20\ \Omega$ load to a $72\ \Omega$ source impedance for optimal power transfer. The transformer is connected to a primary voltage of 50 V, and it draws a current of 1 A.

- (i) Determine the turns ratio required to match the load.
- (ii) Calculate the secondary voltage and current.

[8 marks]

c) A 8-pole AC motor is supplied from 50Hz supply mains, what would be its running speed if the slip is 4%?

[5 marks]

[Total 25 marks]

Question 3

For the following circuit Fig Q3, apply the nodal analysis and the superposition theorem to calculate current flowing through and voltage across the resistor 8 ohm.

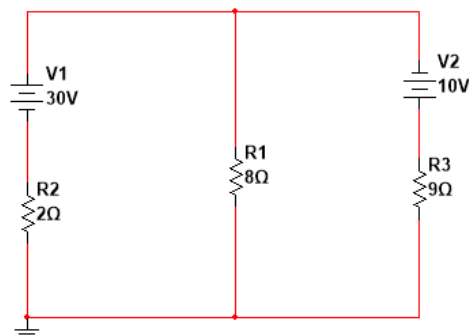


Fig Q3

[Total 25 marks]

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Question 4

a) A 24 V DC motor is used to lift a load at a speed of 1500 RPM. The motor is rated to deliver a mechanical output power of 500 W, and the electrical input power supplied to the motor is measured to be 700 W. Calculate the efficiency of the DC motor.

[4 marks]

b) For the capacitor charging circuit shown in figure Q4b below, where the capacitor is initially discharged.

(i) Sketch two separate graphs for the current I versus time and the capacitor voltage V_c versus time

[8 marks]

(ii) Explain with the assistance of a diagram what happens to the structure of the curves for I versus time and V_c versus time if the time constant $\tau = RC$ for the circuit increases?

[5 marks]

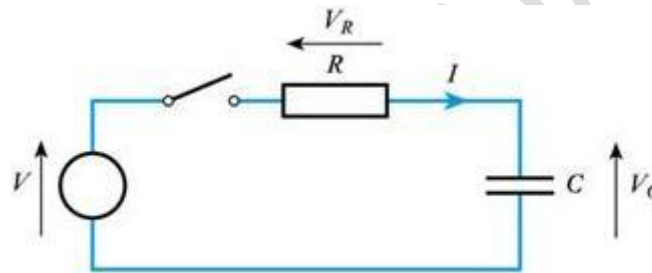


Figure Q4b An initially uncharged capacitor being charged through a resistor.

c) An AC ammeter reads 22 A rms current through a resistive load, and a voltmeter reads 385 V rms drop across the load.

(i) What are the peak values and the average values of alternating current and voltage?

[6 marks]

(ii) Calculate the load resistance.

[2 marks]

[Total 25 marks]

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Question 5

a) For the RLC parallel circuit shown in Fig. Q5a, $R=30\Omega$, $L=10\text{mH}$ and $C=1\mu\text{F}$.

(i) Calculate the current through each branch, (I_R , I_L and I_C).

[5 marks]

(ii) Calculate total current with the phase angle between the voltage.

[6 marks]

(iii) Calculate total impedance.

[2 marks]

(iv) Calculate resonance frequency.

[3 marks]

(v) State whether the circuit is inductive or capacitive and justify your answer.

[4 marks]

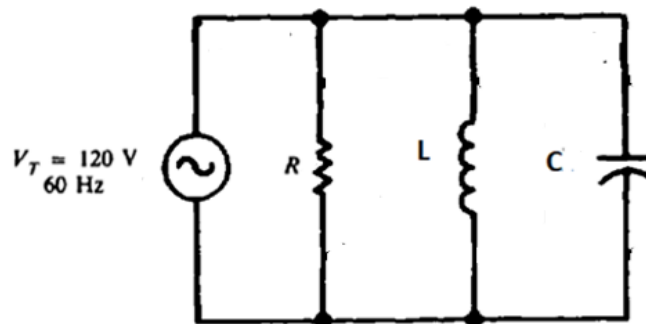


Figure Q5a

b) A conductor carrying a current of 800 A is placed perpendicular (90°) to a magnetic field of 0.5 T. Calculate the force acting on the conductor per unit length.

[5 marks]

[Total 25 marks]

END OF QUESTIONS

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APPENDIX: Formula Sheet

The following symbols in the formulae have their standard meaning:

Ohm's law: $V = IR$

Power: $P = IV$

Magnetic flux: $\Phi = BA$

Induced voltage: $V = \Delta\Phi/\Delta t$

$$f = \frac{pn}{120}$$

Magnitude of the Reactance of Inductor L: $X_L = 2\pi fL$

Magnitude of the Reactance of Capacitor C: $X_C = \frac{1}{2\pi fC}$

Pythagorean theorem: $c^2 = a^2 + b^2$

Tangent function: $\tan A = \text{opposite/adjacent}$

$$\mu_o = 4\pi \times 10^{-7} \text{ H/m}, \quad \epsilon_o = 8.85 \times 10^{-12} \text{ F/m}$$

$$H = \frac{NI}{l}, \quad B = \mu H$$

MMF=N.I

$$L = \frac{\mu_o \mu_r AN^2}{l}, \quad E = \frac{1}{2} LI^2$$

$$C = Q/V, \quad C = \frac{\epsilon A}{d}, \quad E = \frac{1}{2} CV^2$$

$$v_L = L \cdot \frac{di_L}{dt}$$

$$i_C = C \frac{dv_C}{dt}$$

Transformer voltage ratio: $\frac{V_1}{V_2} = \frac{N_1}{N_2}, P = V_1 \cdot I_1 = V_2 \cdot I_2$

Multiply the Value	By	To Get the Value
Peak	2	Peak-to-peak
Peak-to-peak	0.5	Peak
Peak	0.637	Average
Average	1.570	Peak
Peak	0.707	RMS (effective)
RMS (effective)	1.414	Peak
Average	1.110	RMS (effective)
RMS (effective)	0.901	Average

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Summary Table for Series and Parallel RC Circuits

X_C and R in Series	X_C and R in Parallel
I the same in X_C and R	V_T the same across X_C and R
$V_T = \sqrt{V_R^2 + V_C^2}$	$I_T = \sqrt{I_R^2 + I_C^2}$
$Z = \sqrt{R^2 + X_C^2} = \frac{V_T}{I}$	$Z_T = \frac{V_T}{I_T}$
V_C lags V_R by 90°	I_C leads I_R by 90°
$\theta = \arctan\left(-\frac{X_C}{R}\right)$	$\theta = \arctan\frac{I_C}{I_R}$

Summary Table for Series and Parallel RL Circuits

X_L and R in Series	X_L and R in Parallel
I the same in X_L and R	V_T the same across X_L and R
$V_T = \sqrt{V_R^2 + V_L^2}$	$I_T = \sqrt{I_R^2 + I_L^2}$
$Z = \sqrt{R^2 + X_L^2} = \frac{V_T}{I}$	$Z_T = \frac{V_T}{I_T}$
V_R lags V_L by 90°	I_L lags I_R by 90°
$\theta = \arctan\frac{X_L}{R}$	$\theta = \arctan\left(-\frac{I_L}{I_R}\right)$

END OF PAPER