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Mid-Semester Exam (Spring2025)

ECE 101: Basics of Electrical and Electronic Circuits (1st March 2025)

Answer <u>any FOUR</u> questions. Time allowed: <u>90 minutes</u>.

Each question carries 10 marks (Total: 40 marks). Part marks are indicated

Note: Write Code: PXY in bold letters on front page (top right corner, below S.No.) of answer book.

(Q1) Fig.1 shows a sinusoidal ac source of 50 Hz and 300 V (rms) magnitude with a series source-impedance of 15 Ohm resistance in series with 48 milli-Henry inductance. The external load may be connected across 'a' and 'b' terminals of the source. [Note: 'ω' = 314 rad/sec.]

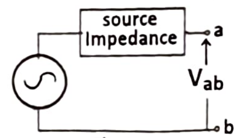


Fig. 1

(i) What will be the rms magnitude of supply current if terminals 'a' and 'b' are shorted? [3]

(ii) Calculate the rms magnitude of load voltage (V_{ab}) if a resistor of 30 Ohm is connected across supply terminals? [4]

(iii) specify the load for which the source current will be maximum (the load may be any combination of resistor, inductor and capacitor of any magnitude)? What will be the rms magnitude of this maximum source current? [3]

(Q2) Find Thevenin's equivalent of circuit connected between terminals 'a' and 'b' of Fig.2. Note the presence of a dependent voltage source. Calculate the magnitude of resistance connected across terminals 'a' and 'b' for drawing maximum power. Also, calculate this maximum power. [4+4+2]

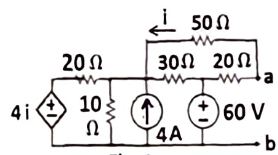


Fig. 2

(Q3) Consider the circuit shown in Fig.3. As shown, 50 volts (rms) is applied to a load consisting of resistors (R_1 and R_2), inductive reactance (X_L) and capacitive reactance (X_C). Find: (a) rms magnitude of supply current I_1 (b) supply current's power factor. (c) active and reactive power supplied by source. Take: $R_1 = 30\Omega$, $R_2 = 20\Omega$, $X_L = 15\ \Omega$ and $X_C = 30\ \Omega$. [3+3+4]

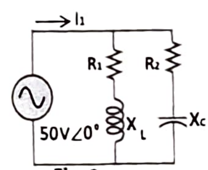


Fig. 3

(Q4) For circuit shown in Fig.4: (a) use superposition principle and find current through 6 Ohm resistance in the direction of arrow. (b) Use mesh analysis to find current through same 6 Ohm resistance. Clearly show calculations for both methods of analysis. [5+5]

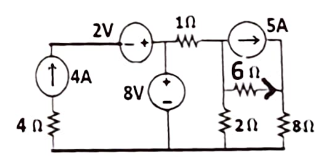


Fig. 4

(Q5) Fig.5 shows a linear time invariant inductor (L) in parallel with a fixed resistor (R). With certain type of voltage v(t) applied across the L-R circuit the inductor current (entering the dotted end) is found to be triangular (as shown). The inductor current varies linearly between -10A to 10A (and vice-versa) at 50 Hz (i.e., T= 0.02 second). For L = 30 milli-Henry and R = 15 Ohm, draw the waveform of current through the resistor R between 0 < t <T. Clearly mark the time and current magnitudes. Calculate the average power (in watts) supplied by the voltage source v(t). [6+4]

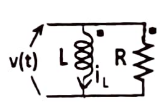
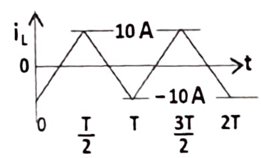


Fig. 5



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