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Indian Institute of Technology, Delhi
Department of Electrical Engineering

Exam: Major Exam
Course: ELL769 (ELECTRICAL SYSTEMS FOR CONSTRUCTION INDUSTRIES)
Date/Time: Wednesday, 06th April 2022, 14.15 pm – 16.15 pm
Mode: Offline, LHC-619, Closed book exam.
Max Marks: 50 Marks
Note: Make suitable assumptions, wherever necessary.

1. Find the angle by which i_1 lags v_1 if $v_1 = 120\ \text{Cos}(120\pi t - 40°)$ V and i_1 equals (–) 0.8 Cos(120πt – 110°) A. (Marks 2)

2. The voltage 8 Ang(–50°) V at a frequency ω = 100 rad/s is applied to a 4 H inductor, and determine the phasor current and the time-domain current. (Marks 3)

3. A 100 μF capacitor and an 5 mH inductor, excited at ω = 10,000 rad/s, are connected in parallel. Find the equivalent impedance. (Marks 2)

4. In the frequency-domain circuit of Fig. 1., find (a) I_1; (b) I_2; (c) I_3 in polar form. (Marks 6)

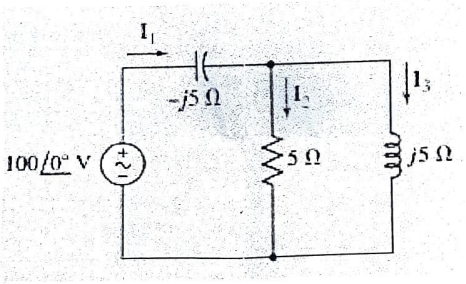

Fig.1.

5. A voltage V = 115√2 Ang(45°) V is applied across an impedance Z = 16.26 Ang(19.3°). Obtain an expression for the instantaneous power, and compute the average power, if ω = 50 rad/s (Marks 4)

6. Calculate the effective value of (a) 6 Cos25t + 5 Cos2(25t) and (b) 6 Cos25t + 5 Sin30t + 4 V. (Marks 4)

7. Calculate the average power delivered to the impedance 6 Ang(25°) Ohm by the current I = 2 + j5 A. (Marks 2)

8. A particular circuit is composed of the series combination of a sinusoidal voltage source 3 Cos(100t – 3°) V, a 500 Ohm resistor, a 30 mH inductor, and an unknown impedance. If we are assured that the voltage source is delivering maximum average power to the unknown impedance, what is its value? (Marks 2)

9. A balanced three-phase system with a line voltage of 300 V is supplying a balanced Y-connected load with 1200 W at a leading PF of 0.8. Find the line current and the per-phase load impedance. (Marks 3)

10. Solve the above question for a Delta connected load. (Marks 3)

11. For the circuit of Fig. 2., determine the power factor of the combined loads if Z_L = 10 Ohm.

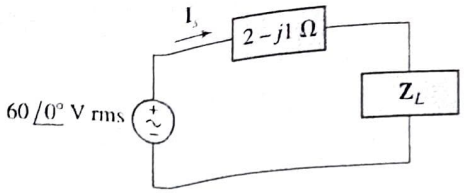

Fig.2.

(Marks 3)

12. A speaker of 9 Ω, resistive impedance is connected to a supply of 10 V with internal resistive impedance of 1 Ω, as shown in Fig. 3(a). (Marks 4)

(a) Determine the power absorbed by the speaker.

(b) To maximize the power transfer to the speaker, a ideal transformer of 1 : 3 turns ratio is used between source and speaker as shown in Fig. 3(b). Determine the power taken by the speaker.

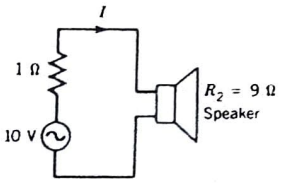

Fig. 3(a)

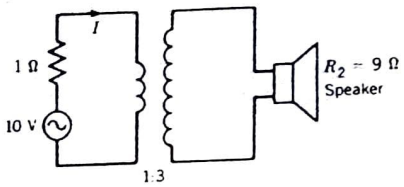

Fig. 3(b)

13. *Tests are performed on a 1ϕ, 10 kVA, 2200/220 V, 60 Hz transformer and the following results are obtained* (Marks 8)

	Open-Circuit Test (high-voltage side open)	Short-Circuit Test (low-voltage side shorted)
Voltmeter	220 V	150 V
Ammeter	2.5 A	4.55 A
Wattmeter	100 W	215 W

Derive the parameters for the approximate equivalent circuits referred to the low-voltage side.

14. Determine v_x in the circuit of Fig. 4. (Marks 2)

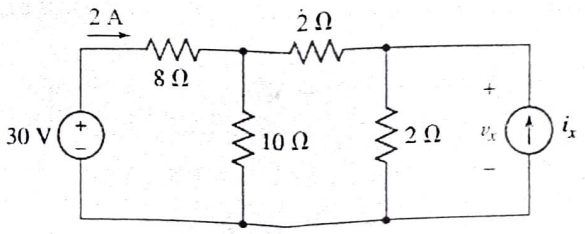

Fig. 4.

15. Determine v in the circuit of Fig. 5. (Marks 2)

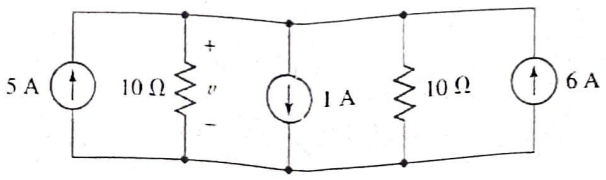

Fig. 5.