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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Second Semester

Electrical and Electronics Engineering

EE 3251 – ELECTRIC CIRCUIT ANALYSIS

(Common to: Electronics and Instrumentation Engineering and Instrumentation and Control Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. In a room, a 100W electric lamp is connected to a 250V supply. Determine (a) the current flowing in the bulb, and (b) the resistance of the bulb.

2. Draw the power triangle of ac circuits.

3. Write the condition for maximum power transfer in a.c. circuits, if the load consists of a purely variable resistance.

4. State Thevenin's theorem.

5. A 20 μF capacitor is connected in series with a 50 kΩ resistor and the circuit is connected to a 20 V, d.c. supply. Determine the time constant of the circuit.

6. List the two main methods that are used to draw transient curves graphically.

7. A filter in the form of a series L–R–C circuit is designed to operate at a resonant frequency of 10 kHz. Included within the filter is a 10 mH inductance and 5 Ω resistance. Determine the bandwidth of the filter.

8. Write the formula for calculating Q - factor of a parallel resonant circuit.

9. Two wattmeters are connected to measure the input power to a balanced 3-phase load by the two-wattmeter method. If the instrument readings are 8 kW and 4 kW, determine the total power input.

10. List any two advantages of 3 phase systems.

PART B — (5 × 13 = 65 marks)

11. (a) Determine the node to reference voltages for the circuit shown in Fig. 1. (13)

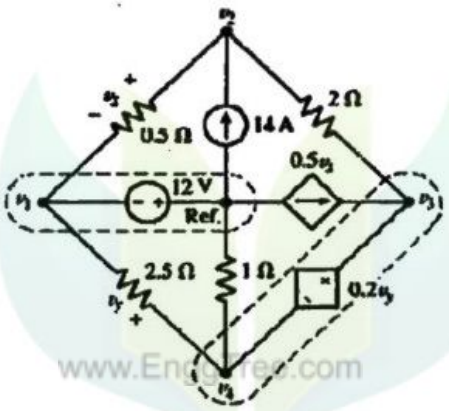

Fig. 1

Or

(b) Obtain a relationship between root mean square value and peak value of a sinusoidal signal. (13)

12. (a) Find the Norton equivalent circuit for the circuit shown in Fig.2 at terminals *a*-*b*. (13)

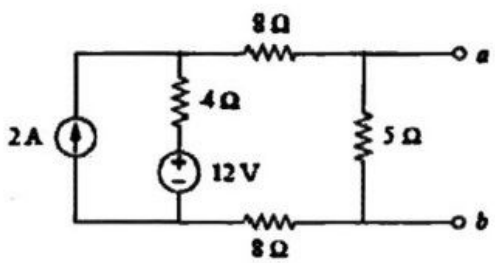

Fig. 2

Or

(b) Obtain the equivalent resistance R_{ab} for the circuit shown in Fig. 3 using star-delta conversion. (13)

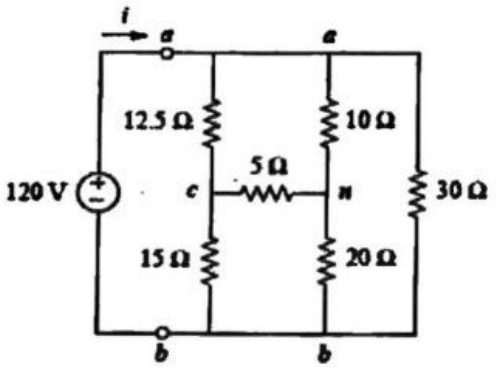

Fig. 3

13. (a) A circuit consists of a resistor connected in series with a 0.5 μF capacitor and has a time constant of 12 ms. Determine (13)

(i) the value of the resistor,

(ii) the capacitor voltage 7 ms after connecting the circuit to a 10 V supply.

Or

(b) A coil of inductance 0.04 H and resistance 10 Ω is connected to a 120 V, d.c. supply. Determine (i) the final value of current, (ii) the time constant of the circuit, (iii) the value of current after a time equal to the time constant from the instant the supply voltage is connected, (iv) the expected time for the current to rise to within 1% of its final value. (13)

14. (a) A series circuit comprises a 10 Ω resistance, a 5 μF capacitor and a variable inductance L. The supply voltage is 206 $\angle 0°$ volts at a frequency of 318.3 Hz. The inductance is adjusted until the p.d. across the 10 Ω resistance is a maximum. Determine for this condition (i) the value of inductance L, (ii) the p.d. across each component and (iii) the Q-factor. (13)

Or

(b) A coil of inductance 5 mH and resistance 10 Ω is connected in parallel with a 250 nF capacitor across a 50 V variable-frequency supply. Determine (i) the resonant frequency, (ii) the dynamic resistance, (iii) the current at resonance, and (iv) the circuit Q-factor at resonance. (13)

15. (a) A balanced, three-wire, star-connected, 3-phase load has a phase voltage of 240 V, a line current of 5 A and a lagging power factor of 0.966. Draw the complete phasor diagram and also write the procedure to construct the phasor diagram. (13)

Or

(b) Explain the two wattmeter method of measuring three phase power with neat circuit connections. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A coil of inductance 120 mH and resistance 150 Ω is connected in parallel with a variable capacitor across a 20 V, 4 kHz supply. Determine for the condition when the supply current is a minimum, (i) the capacitance of the capacitor, (ii) the dynamic resistance, (iii) the supply current, (iv) the Q-factor, (v) the bandwidth. (15)

Or

(b) The winding of an electromagnet has an inductance of 3 H and a resistance of 15 Ω. When it is connected to a 120 V, d.c. supply, calculate:

(i) the steady state value of current flowing in the winding.

(ii) the time constant of the circuit,

(iii) the value of the induced e.m.f. after 0.1 s,

(iv) the time for the current to rise to 85% of its final value, and

(v) the value of the current after 0.3 s. (15)