Reg. No. : | | | | | | | | | | | | |

Question Paper Code: R2305

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Second Semester

Electrical and Electronics Engineering

R21UEE205 - ELECTRIC CIRCUIT ANALYSIS

(Regulations R2021)

Duration: Three hours | Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

1. Two bulbs B_1 100 W, 200 V and B_2 40 W, 200 V are connected in series across 400 V supply, the total circuit resistance will be. CO2-App

   (a) 400 Ω (b) 1400 Ω (c) 1000 Ω (d) 285.71Ω

2. Explain Ohm's law using the relationship between voltage, current, and resistance: CO1-U

   (a) Voltage is directly proportional to resistance

   (b) Current is directly proportional to voltage

   (c) Current is directly proportional to power

   (d) Resistance is inversely proportional to power.

3. Apply the formula for RMS value to calculate the RMS voltage of a sine wave with a peak voltage of 100V: CO2-App

   (a) 50V (b) 70.7V (c) 100V (d) 141.4V

4. Explain why power factor is important in AC circuits: CO1-U

   (a) It measures the resistance of the circuit.

   (b) It indicates how effectively electrical power

   (c) It determines the voltage of the circuit.

   (d) It shows the current flowing in the circuit

5. Compare Thevenin and Norton theorems: CO1-U

(a) Circuits with time-varying components only

(b) Thevenin uses a voltage source, and Norton uses a current source

(c) Norton applies only to DC circuits, while Thevenin applies to AC circuits

(d) Thevenin is for series circuits, and Norton is for parallel circuits

6. Explain the Maximum Power Transfer Theorem: CO1-U

(a) Power transfer is maximum when the load impedance is twice the source impedance.

(b) Power transfer is maximum when the load impedance equals the source impedance.

(c) Maximum power is delivered only in purely resistive circuits

(d) Maximum power occurs when the circuit has no load connected.

7. Explain the difference between series and parallel resonance: CO1-U

(a) Series resonance occurs at maximum impedance, and parallel resonance occurs at minimum impedance.

(b) Series resonance occurs at minimum impedance, and parallel resonance occurs at maximum impedance.

(c) Both occur at the same impedance.

(d) Series resonance is applicable only to DC circuits.

8. Classify the types of tuned circuits: CO1-U

(a) Active and passive (b) Series-tuned and parallel-tuned

(c) Inductive and capacitive (d) High-frequency and low-frequency

9. Solve the time-domain response for an RLC circuit with R=5 Ω, L=1 H, and C=0.1 F for a DC input Vs=10 V CO5-App

(a) Overdamped (b) Critically damped (c) Underdamped (d) Sin steady-state

10. Identify the time constant (τ) for an RC circuit with R=10 Ω and C=100 μF CO5-App

(a) 1 ms (b) 10 ms (a) 100 ms (b) 1 s

PART – B (5 x 2= 10 Marks)

11. Illustrate how Kirchhoff's Current Law (KCL) is applied in a circuit node CO1-U

12. Calculate the total current in a parallel RC circuit with V=120V, R=20Ω, and C=50μF at f=60Hz CO2-App

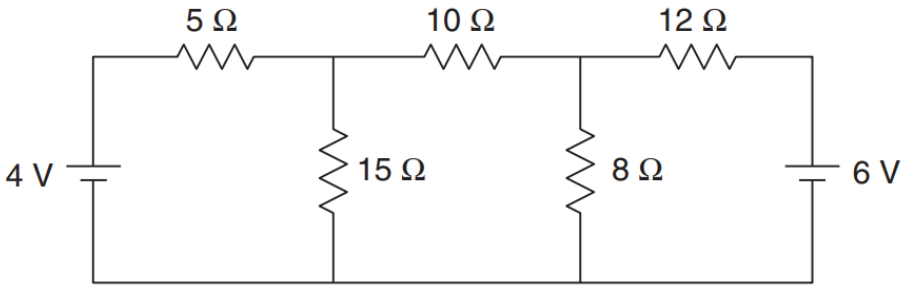
13. Demonstrate how to use the Superposition Theorem for a circuit with two sources CO1-U

14. Describe how bandwidth is related to the quality factor in a resonant circuit CO1-U

15. Identify the key differences between the transient response of an RL circuit and an RC circuit when a DC input is applied CO1-U

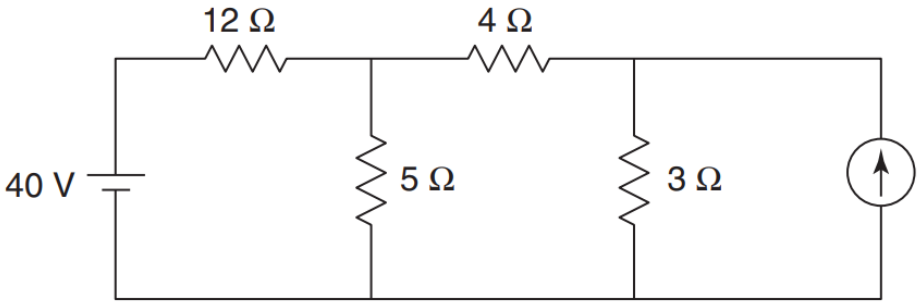
PART – C (5 x 16= 80 Marks)

16. (a) Using Kirchoff laws Find the current through the 8Ω resistor in Figure CO2-App (16)



Or

(b) Find the current through the 4Ω resistor in Figure using source transformation CO2-App (16)

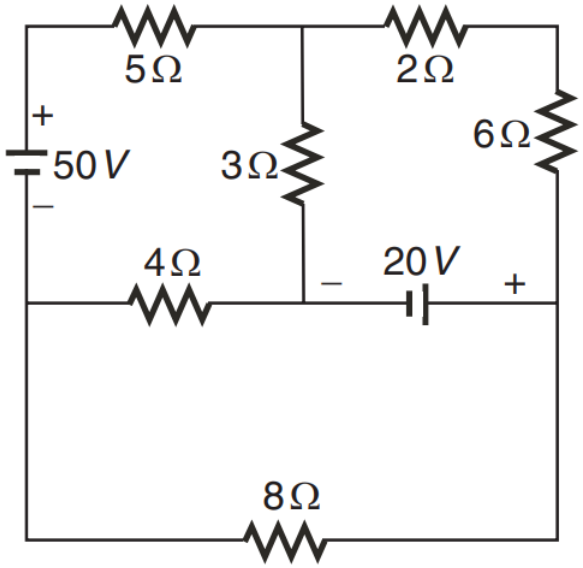


17. (a) A resistance of 16Ω is connected in parallel to an inductance of 20 mH and the parallel combination is connected to an ac supply of 230V, 50Hz. Determine the current through the elements and power delivered by the source. Draw the phasor diagram CO2-App (16)

Or

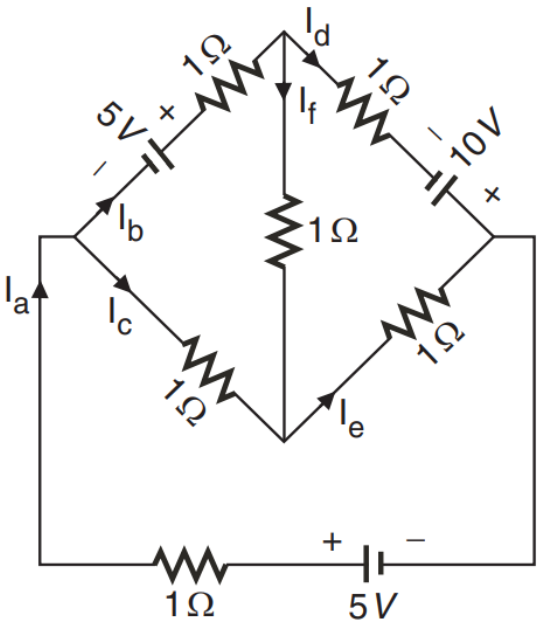
(b) A series combination of 12Ω resistance and 600 µF capacitance is connected to a 220V, 50 Hz supply. Estimate the current, active power, reactive power and apparent power. Also estimate the voltage across R and C and draw the phasor diagram CO2-App (16)

18. (a) Solve the currents in various branches of the circuit shown in Figure, by mesh analysis CO3-App (16)



Or

(b) Determine the currents in various elements of the bridge circuit shown in Figure, using mesh analysis CO3-App (16)



19. (a) Analyze the performance of a series RLC circuit with R = 40 Ω, L = 150 mH, and C = 0.3 μF by performing the following tasks: CO4-App (16)
    a) Determine and examine the resonant frequency of the circuit.
    b) Analyze the circuit to evaluate the quality factor and its impact on resonance sharpness.
    c) Break down the circuit behavior to identify the bandwidth based on the calculated quality factor.
    d) Compare the impedance of the circuit at a frequency equal to 0.8 times the resonant frequency with its impedance at resonance.
    e) Interpret and assess the phase angle between current and voltage at 0.8 times the resonant frequency, relating it to circuit reactance

Or

(b) Analyze the behavior of a series RLC circuit with R = 15 Ω, L = 80 mH, and C = 0.25 μF by performing the following tasks: CO4-App (16)
    a) Determine and interpret the resonant frequency of the circuit.
    b) Compare and analyze the inductive reactance (XL) and capacitive reactance (XC) at resonance.
    c) Break down the circuit operation to calculate the current at resonance when the applied voltage is V = 12 V.
    d) Examine and interpret the voltage developed across the inductor (VL) and capacitor (VC) at resonance.
    e) Assess and explain the phase difference between current and voltage at resonance.

20. (a) A series RLC circuit consists of a 4 Ω resistor, a 1 H inductor, and a 0.25 F capacitor. A 20 V DC step input is applied at t = 0, and the circuit is initially at rest, meaning there is no initial current ($i(0^-)=0$ and the capacitor is uncharged ($Vc(0^-)=0$. Using Laplace transforms, determine the expression for the current i(t) for $t \geq 0$. CO5-Ana (16)

Or

(b) A series RLC circuit consists of a 4 Ω resistor, a 1 H inductor, and a 0.25 F capacitor. Initially, the circuit is at rest, meaning the current and capacitor voltage are both zero ($i(0^-)=0$, $Vc(0^-)=0$. At t=0, a 20 V DC source is suddenly applied. The tasks include writing the governing differential equation for the circuit, calculating the damping ratio (ζ) and natural frequency (ωn), and classifying the damping as underdamped, critically damped, or overdamped. Additionally, derive the expression for the current i(t) using Laplace transforms, and plot the transient response of i(t). CO5-Ana (16)