Register Number:……..

KUMARAGURU college of technology
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B.E/B.TECH DEGREE EXAMINATIONS: NOV /DEC 2024

(Regulation 2024)

First Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

24EEI101: Electric Circuits and Networks

COURSE OUTCOMES

CO1: Analyse and interpret the behaviour of electric circuits by applying circuit laws.
CO2: Apply mesh analysis, nodal analysis, and network theorems to analyse the behaviour of electric circuits.
CO3: Analyse the transient response of first-order and second-order systems to step and sinusoidal input.
CO4: Apply phasor diagram techniques to represent and analyse voltages and currents in three-phase systems.
CO5: Analyse the frequency response of series and parallel RLC circuits and explain the behaviour of magnetically coupled circuits.

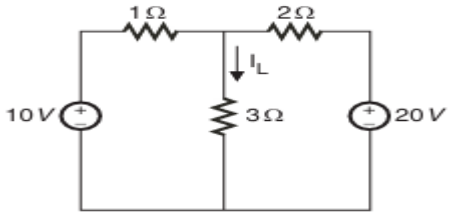
Time: Three Hours **Maximum Marks: 100**

PART A (4*20 = 80 Marks)
Answer all the Questions

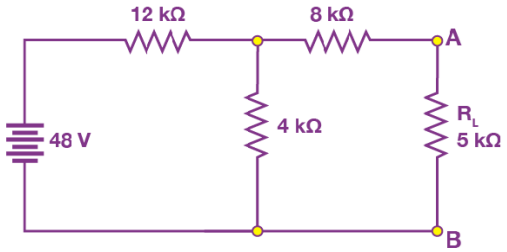
1.	a)	State Ohm's law and write its application in electric circuits.	2	CO1	[K_1]
	b)	Differentiate between real power and reactive power.	2	CO1	[K_2]
	c)	**Scenario:** Design a power distribution circuit for a residential building that requires multiple connections for lighting and appliances. For a residential circuit, calculate the total resistance when $R_1 = 4\,\Omega$, $R_2 = 6\,\Omega$, and $R_3 = 12\,\Omega$ are connected in parallel. Determine the total current drawn from a 24V DC source.	6	CO1	[K_4]
	d)	A single-phase AC circuit consists of $R = 10\,\Omega$, $L = 0.1$ H, and $C = 50\,\mu$F. Calculate the impedance and the power factor of the circuit when connected to a 230V AC source at 50Hz.	6	CO1	[K_4]
	e)	Design a simple lighting circuit for a home using a series and parallel combination of resistances. Provide the circuit diagram and calculate the total current flows through the circuit for 5 lamps rated at 100W each, assuming a 220V supply.	4	CO1	[K_4]

2.	a)	List the significance of transient response in electric circuits.	2	CO3	[K1]
	b)	Explain the source free condition for analysing the transient response of RC circuits.	2	CO3	[K3]
	c)	A 110 V DC source is applied to series RL circuit has $R = 40\,\Omega$ and $L = 0.5$ H. The initial current is 2A. Derive the expression for current $i(t)$ for $t > 0$.	6	CO3	[K4]
	d)	Derive the step response of an RLC series circuit when subjected to a unit step voltage input.	6	CO3	[K4]
	e)	Derive the transient response of a source-free RC circuit with $R = 1\,\text{k}\Omega$, $C = 10\,\mu$F, and an initial voltage of 5V across the capacitor.	4	CO3	[K4]
3.	a)	Define phase sequence and write its importance in three-phase systems.	2	CO4	[K1]
	b)	Differentiate between star and delta connections in three-phase systems.	2	CO4	[K2]
	c)	A three-phase balanced star-connected load has an impedance of $10 + j5\,\Omega$ per phase. Calculate the line and phase currents when connected to a 400V, 50Hz supply.	6	CO4	[K4]
	d)	Derive the expressions for power in three-phase systems using the two-wattmeter method.	6	CO4	[K3]
	e)	Explain the significance of power factor in three-phase systems and its effect on energy efficiency.	4	CO4	[K2]
4.	a)	Define quality factor in series resonance and its significance in circuit design.	2	CO5	[K1]
	b)	Differentiate between self and mutual inductance in magnetically coupled circuits.	2	CO5	[K2]
	c)	A series RLC circuit has $R = 5\,\Omega$, $L = 1$ H, and $C = 50\,\mu$F. Calculate the resonant frequency, quality factor, and bandwidth of the circuit.	12	CO5	[K4]
	d)	Compare series and parallel resonance circuits in terms of frequency response and power transfer.	4	CO5	[K3]

PART B (1 x 20 = 20 Marks)
Answer any ONE Question

5.	a)	State Kirchhoff's Voltage Law (KVL).	2	CO2	[K_1]
	b)	Discuss the significance of the maximum power transfer theorem.	2	CO2	[K_2]
	c)	Apply superposition theorem, find the current through the 3Ω resistance in the circuit. 	6	CO2	[K_4]
	d)	Explain the duality principle in electrical circuits and provide the steps to construct dual network with suitable example.	6	CO2	[K_3]
	e)	Derive the star-to-delta conversion formula for a resistive network.	4	CO2	[K_3]

OR

6.	a)	Define mesh analysis and its applications in electric circuits.	2	CO2	[K_1]
	b)	Discuss the concept of source transformation in electric circuits.	2	CO2	[K_3]
	c)	Apply Thevenin's theorem to determine the equivalent circuit for a circuit given below with respect to terminals A&B. 	12	CO2	[K_4]
	d)	State Norton's theorem and discuss the practical limitations of Norton's theorem in real-world circuit applications.	4	CO2	[K_3]

CO distribution summary:

	CO1	CO2	CO3	CO4	CO5
Marks (%)	20	20	20	20	20

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