

25HEET401	NETWORK ANALYSIS AND SYNTHESIS	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course equips students with the knowledge and skills to analyze and design electrical networks. It covers techniques like mesh and nodal analysis, network theorems, source transformations, and Laplace transform for DC and AC circuits, including transient and steady-state behavior. Students also learn to evaluate resonance, power parameters, two-port networks, and design passive filters for specific frequency responses.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Apply mesh and nodal analysis, network theorems, and source transformation techniques to analyze DC and AC circuits with independent and dependent sources.	K3 Apply
CO2	Analyze resonance phenomena and evaluate power parameters in balanced and unbalanced three-phase circuits under steady-state conditions.	K3 Apply
CO3	Analyze the transient response of RL, RC, and RLC circuits with DC and sinusoidal excitation using Laplace transform techniques.	K3 Apply
CO4	Evaluate and analyze two-port networks using various parameter and design passive filters for specified frequency characteristics.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	2	1	1
CO2	3	3	1	2	-	-	-	-	-	-	2	1	2
CO3	3	3	1	2	-	-	-	-	-	-	2	3	2
CO4	3	3	2	2	-	-	-	-	-	-	2	3	3
Avg	3	3	1.25	1.75	-	-	-	-	-	-	2	2	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	*	-	*	-
CO2	*	*	*	*	*	*	-	*	-
CO3	*	*	*	*	*	*	-	*	-
CO4	*	*	*	*	*	*	-	*	-

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5Hours

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment	: 15 marks

SYLLABUS

Module 1 (14 Hours)

Mesh analysis and nodal analysis (Review only)- super mesh and super node - Superposition principle - source transformation – analysis with DC and AC (sinusoidal) excitation

Thevenin's theorem – Norton's theorem - Maximum power transfer theorem - analysis with DC and AC (sinusoidal) excitation with independent and dependent sources. Reciprocity Theorem - application to the analysis of DC Circuits.

Module 2 (14 Hours)

Resonance - series resonance– resonant frequency – variations of impedance and current with frequency – bandwidth – quality factor–parallel resonance

Power in 3-phase circuits – complex power - active, reactive and apparent power in balanced load – steady state analysis of 3-wire unbalanced delta connected circuit - steady state analysis of 3-phase 4-wire and 3-wire (using Millman's theorem only) unbalanced star connected circuit –neutral shift

Module 3 (14 Hours)

Introduction to transient response and steady state response, Transient response of series –RL,RC, RLC

Circuits for D.C excitation with Initial Conditions, Solutions using Differential Equations approach, Illustrative problems.

Coupled circuit – dot convention – fixing of dots – coefficient of coupling - conductively coupled equivalent circuit - sinusoidal steady state analysis of coupled circuits

Module 4 (14 Hours)

Impedance Parameters, Admittance Parameters, Hybrid Parameters, Transmission (ABCD) Parameters, Conversion of one parameter to another parameter, Conditions for Reciprocity and symmetry, Interconnection of two port networks in series, parallel and cascaded configurations, Illustrative problems.

Filter terminology: Low pass, high pass, band-pass and band-reject filters. Constant k and m-derived filters -- low pass, high pass, band-pass and band-stop filters -- design--effect of cascading multiple sections.

Text Books

1. Mano, M. M. (2013). *Digital logic and computer design* (4th ed.). Pearson Education.
2. Floyd, T. L. (2009). *Digital fundamentals* (10th ed.). Pearson Education.
3. Palnitkar, S. (2003). *Verilog HDL: A guide to digital design and synthesis* (2nd ed.). Pearson.

Reference Books

1. Mano, M. M., & Ciletti, M. D. (2013). *Digital design with an introduction to the Verilog HDL* (5th ed.). Pearson Education.
2. Givone, D. D. (2003). *Digital principles and design*. Tata McGraw-Hill.
3. Wakerly, J. F. (2011). *Digital design: Principles and practices* (5th ed.). Pearson.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER (STC 2025 SCHEME)

Course Code	25HEET401
Course Name	NETWORK ANALYSIS AND SYNTHESIS
Max. Marks: 60	Duration: 2.5 Hours

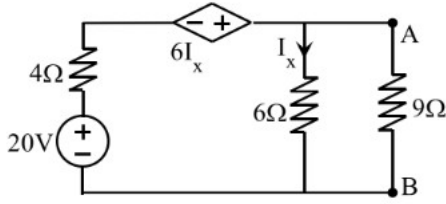
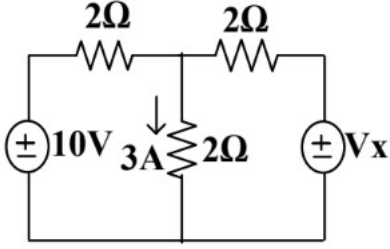
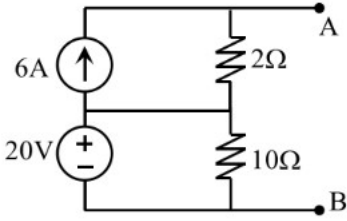
Part A				
(Answer all questions. Each question carries 3 marks)				
Qn No.	Question	Marks	CO	BL
1	Explain the condition for maximum power transfer in DC circuits.	3	1	L2
2	Describe the principle of source transformation.	3	1	L2
3	Interpret the significance of resonant frequency in a series resonant circuit.	3	2	L2
4	Explain active, reactive, and apparent power in a three-phase circuit.	3	2	L2

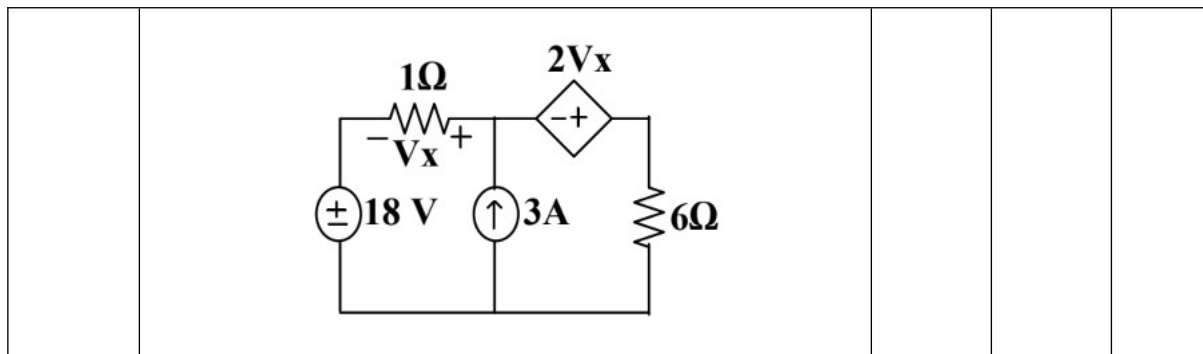
5	Explain the transient response of an RL circuit.	3	3	L2
6	Summarize the significance of the coefficient of coupling in coupled circuits.	3	3	L2
7	Describe the conditions for reciprocity and symmetry in a two-port network.	3	4	L2
8	Explain the operation of a low-pass filter.	3	4	L2

Part B

(Answer any one full question from each Module. Each carry 9 marks)

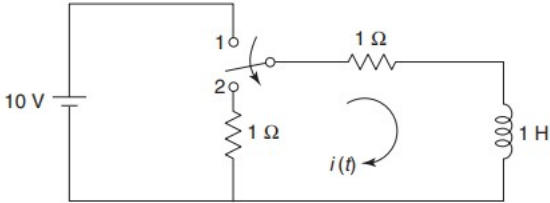
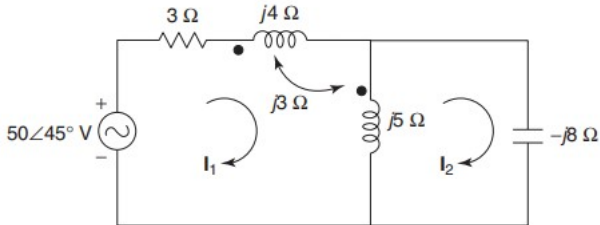
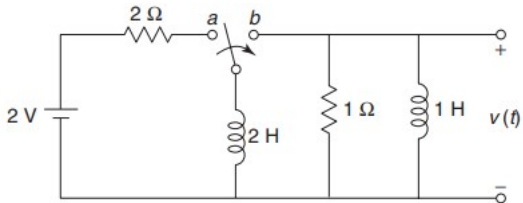
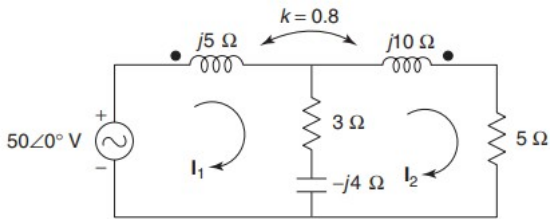
Module I

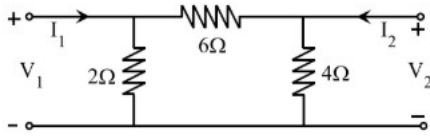
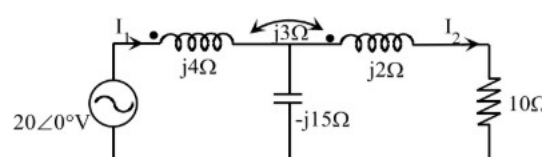
Qn No.	Questions	Marks	CO	BL
9.a	For the circuit shown below, calculate current I_L through 9Ω using Thevenin's theorem. 	5	1	L3
9.b	Using superposition theorem determine V_x. Also calculate the power delivered by V_x. 	4	1	L2
OR				
10.a	Construct Norton's equivalent circuit across the terminals A and B in the circuit shown below. 	5	1	L3
10.b	Using Thevenin's theorem, calculate the current in the 6Ω resistor of the following circuit.	4	1	L2



Module II

Qn No.	Questions	Marks	CO	BL
11.a	A three-phase, three-wire supply of 400 V is connected to an unbalanced delta load: $Z_{RY}=10\angle 30^\circ \Omega$,$Z_{YB}=15\angle 45^\circ \Omega$,$Z_{BR}=20\angle 60^\circ \Omega$ calculate: - Phase currents. - Line currents. - Total active power.	5	2	L3
11.b	A resistor, a capacitor and an inductor are connected in series with a 230V, variable frequency AC source. When the supply frequency is varied to 25Hz, the circuit offered a minimum impedance of 50Ω. If the inductance of the circuit is 1H, compute the following; (i) Resistance and capacitance of the circuit. (ii) The voltage across the capacitor. (iii) Q factor at resonance and bandwidth of the circuit. (iv) Halfpower frequencies	4	2	L3
OR				
12.a	A 400/230 V three-phase four-wire system supplies an unbalanced star load: $Z_R=10 \Omega$ $Z_Y=15 \Omega$ $Z_B=20 \Omega$ calculate - Phase currents. - Neutral current. - Total power consumed.	5	2	L3
12.b	A series RLC circuit is connected to a 200 V ac supply. The current drawn by the circuit at resonance is 20 A. The voltage drop across the capacitor is 5000V at series resonance. Calculate resistance and	4	2	L2

	inductance if capacitance is $4\mu\text{F}$. Also, calculate the resonant frequency.			
Module III				
Qn No.	Questions	Marks	CO	BL
13. a	In the network of Figure, the switch is moved from the position 1 to 2 at $t = 0$, steady-state condition having been established in the position 1. Calculate $i(t)$ for $t > 0$ 	5	3	L3
13. b	Compute the current through the capacitor in fig using mesh analysis. 	4	3	L2
OR				
14. a	The network of figure was initially in the steady state with the switch in the position a. At $t = 0$, the switch goes from a to b. Compute an expression for voltage $v(t)$ for $t > 0$. 	5	3	L3
14. b	Calculate the voltage across the 5Ω resistor in figure using mesh analysis 	4	3	L2
Module IV				
Qn No.	Questions	Marks	CO	BL

15. a	Two identical networks as shown in figure below are connected in parallel. Calculate Y parameters of the resultant combination. Is the combined network reciprocal? 	5	4	L3
15. b	Develop a relationship between following parameters. (i) ABCD parameters in terms of Y parameters (ii) Y parameters in terms of hybrid parameters.	4	4	L2
OR				
16. a	For the network shown below. Calculate the voltage across 10Ω resistance. 	5	4	L3
16. b	Develop a constant-k band-pass filter having: • Lower cut-off frequency = 1 kHz • Upper cut-off frequency = 4 kHz • Nominal impedance = 600 Ω Calculate the values of inductors and capacitors.	4	4	L2
