Techno India NJR Institute of Technology

Course File

Network Theory (3EC4-06)

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(Assistant Professor)

Department of Electrical Engineering

3EC4-06: Network Theory

4 Credits **Max. Marks: 100 (IA:30, ETE:100)**

3L:1T:0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality.	7
2	Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits.	7
3	Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.	8
4	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions..	8
5	Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.	10
	Total	**40**

Course Overview:

The student will learn electrical circuit analysis in this 40-hour course. This course includes network theorems, solution of first and second order networks, sinusoidal steady state analysis, electrical circuit analysis using Laplace transforms, two port networks and network functions. This course will increase the student ability of solving the electrical circuits using the different types of theorems. It will also increase the knowledge about the response of the RL, RC and RLC network responses under different input conditions.

This course is very important for analysing any circuit. This is also necessary for the upcoming subjects during the course work. Also, most of the interviewers ask questions from this subject to check the fundamentals of circuit analysis that is why it plays vital role in recruitment process.

Course Outcome:

CO. NO.	Cognitive Level	Course Outcome
1	Synthesis	Student will be able to apply the basic circuital law and simplify the network using network theorems.
2	Synthesis	Student will be able to categorize the frequency domain techniques in different applications.
3	Application	Students will be able to apply Laplace Transform for steady state and transient analysis.
4	Analysis	Students will be able to evaluate transient response and two-port network parameters.
5	Analysis	Students will be able to analyze the series resonant and parallel resonant circuit and design filters.

Prerequisites:

1. Fundamentals of basic circuit elements and their properties.
2. Students should be efficient in applying basic laws of circuit analysis like KVL, KCL.
3. Students should be proficient in solving algebraic equations.
4. Students should be proficient in integral and differential equations solution.

Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	3	2	-	-	-	-	-	-	-
CO2	3	3	1	2	2	-	-	-	-	-	-	1
CO3	3	2	2	-	2	-	-	-	-	-	-	1
CO4	2	3	2	2	1	-	-	-	-	-	-	-
CO5	2	3	3	2	1	-	-	-	-	-	-	-
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)												

Course Coverage Module Wise:

Lect. No.	Unit	Topic
1	**1**	**NODE AND MESH ANALYSIS**
2	1	Numerical on Node and Mesh Analysis
3	1	matrix approach of network containing voltage and current sources, and reactance
4	1	(Cont.) matrix approach of network containing voltage and current sources, and reactance
5	1	Numerical on matrix approach of network containing voltage and current sources, and reactance
6	1	Source transformation and duality
7	1	Numerical on source transformation
8	1	Duality theorem
9	1	Numerical on duality theorem
10	**2**	**NETWORK THEOREMS:** Superposition theorem for AC circuit
11	2	Numerical on Superposition theorem
12	2	Thevenin's and Norton's theorem for AC circuit
13	2	Numerical on Thevenin's and Norton's theorem
14	2	Maximum power Transfer and reciprocity theorem for AC circuit
15	2	Numerical on Maximum power Transfer and reciprocity theorem
16	2	Compensation and Tallegen's theorem for AC circuit
17	2	Numerical on compensation and Tallegen's

18	**3**	**TRIGONOMETRIC AND EXPONENTIAL FOURIER SERIES:** Discrete spectra and symmetry of waveform
19	3	Steady state response of a network to nonsinusoidal periodic inputs
20	3	Numerical on steady state response of a network to nonsinusoidal periodic inputs
21	3	Power factor, effective values
22	3	Fourier transform and continuous spectra
23	3	Numerical on Fourier transform and effective values
24	3	Three phase unbalanced circuit and power calculation
25	3	Numerical on three phase unbalanced circuit and power calculation.
26	**4**	**LAPLACE TRANSFORMS AND PROPERTIES:** Partial fractions, singularity functions
27	4	Waveform synthesis and analysis of RC, RL network without initial conditions with Laplace transforms
28	4	Waveform synthesis and analysis of RC, RL network with initial conditions with Laplace transforms evaluation of initial conditions
29	4	Numerical on waveform synthesis and analysis of RC, RL network without initial conditions with Laplace transforms
30	4	Numerical on Waveform synthesis and analysis of RC, RL network with initial conditions with Laplace transforms evaluation of initial conditions
31	4	Waveform synthesis and analysis of RLC network without initial conditions with Laplace transforms
32	4	Waveform synthesis and analysis of RLC network with initial conditions with Laplace transforms evaluation of initial conditions
33	4	Numerical on Waveform synthesis and analysis of RLC network without initial conditions with Laplace transforms
34	4	Numerical on Waveform synthesis and analysis of RLC network with initial conditions with Laplace transforms evaluation of initial conditions
35	**5**	**TRANSIENT BEHAVIOR, CONCEPT OF COMPLEX FREQUENCY**
36	5	Driving points and transfer functions poles and zeros of admittance function
37	5	Properties of Driving points and transfer functions
38	5	Sinusoidal response from pole-zero locations
39	5	Numerical on Driving points and transfer functions
40	5	Numerical on sinusoidal response from pole-zero locations

Text/Reference Books:

1. Circuits and Networks: Analysis And Synthesis, Sudhakar, TMH
2. Sivanagaraju – Electrical circuit analysis, Cengage learning
3. Robbins – Circuit analysis: Theory and Practice, Cengage Learning
4. Electrical Networks, Singh, TMH
5. Electric Circuits, Nilsson, Pearson 2009
6. Linear Circuits Analysis, Decarlo, Oxford 2007
7. Basic Engineering Circuit Analysis, Irwin, Wiley 2010
8. Network Theory: Analysis and Synthesis, Smarjit Ghosh, PHI 2
9. Electric Circuit Analysis, Xavier, S.P. Eugene, New Age

Teaching and Learning resources:

NPTEL Course Link	https://nptel.ac.in/courses/108/105/108105159/
Quiz	https://www.objectivebooks.com/2016/11/circuits-circuit-theory-mcq-test.html
Notes	https://sites.google.com/site/eeenotes2u/courses/network-analysis

Assessment Methodology:

1. Assignments one from each unit.
2. Midterm subjective paper where they have to solve the given problem. (Twice during the semester)
3. Final paper at the end of the semester subjective

Previous Year Question Paper:

3E1149

Roll No. _____

Total No of Pages: 4

3E1149

B. Tech. III - Sem. (Main / Back) Exam., Dec. 2019
PCC Electronics & Communication Engineering
3EC4-06 Network Theory
Common For EC, EI

Time: 3 Hours **Maximum Marks: 160**

Instructions to Candidates:

Attempt all ten questions from Part A, fiver questions out of seven questions from Part B and four questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×3=30]**

All questions are compulsory

Q.1 State the Kirchhoff's voltage law.

Q.2 Define the node, junction, and branch of electric circuits.

Q.3 Write down the statement of superposition theorem.

Q.4 Explain the reciprocity theorem.

Q.5 Represents wave of even, odd, and half symmetry.

Q.6 Explain the shifting of function.

Q.7 Define the Laplace transformation.

Q.8 State the initial and final value theorem.

Q.9 Write down the properties of filter.

Q.10 State the convolution theorem.

PART – B

(Analytical/Problem solving questions)

Attempt any four questions [5×10=50]

Q.1 Find current through the 5Ω resistor in figure 1.

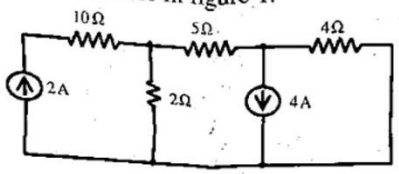


Fig .1.

Q.2 Obtain Thevenin's equivalent circuit across X –Y. (figure 2)

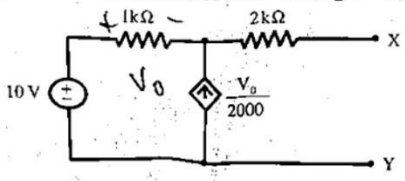


Fig .2.

Q.3 Determine the effective value of f (t) of the waveform shown in figure 3.

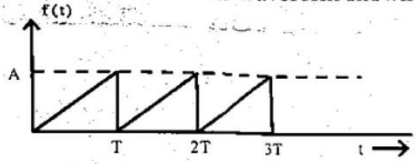


Fig .3.

Q.4 A function in s – domain is given by -

$$F(S) = \frac{50}{S^2 + 2S + 2}$$

Find the inverse Laplace transform.

Q.5 State whether the following function are driving point immittance of LC network or not:

(a) $z(s) = \frac{10(s^2+4)(s^2+6)}{(s^2+1)(s^2+9)}$

(b) $z(s) = \frac{5s(s^2+4)}{(s^2+1)(s^2+3)}$

Q.6 The current I_1 and I_2 at input and output port respectively of a two port network can be expressed as:

$I_1 = 5V_1 - V_2$

$I_2 = -V_1 + V_2$

Find the equivalent π - network.

Q.7 Determine the relationship between the resonance frequency f_0 and the half power frequency f_1 and f_2 in a series resonating circuit. [1680]

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[4×20=80]**

Attempt any two questions

Q.1 (a) Determine the node voltage and the current through the resistors using mesh method for the network shown in figure. 1(a)

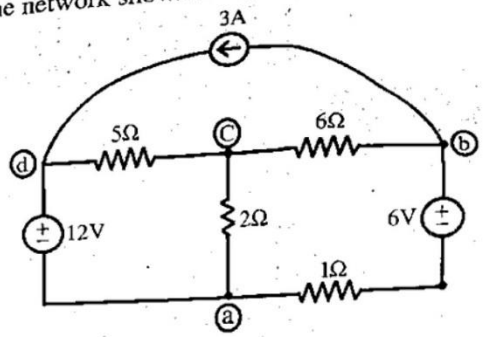


Fig.1.(a)

(b) Form the nodal equations for the network shown in figure 1(b)

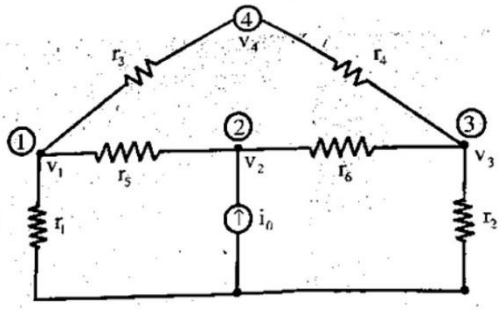


Fig.1.(b)

Q.2 Figure 2 represents a mixed circuit. Find the magnitude of V_0 by superposition theorem and find the power produced by each of the sources.

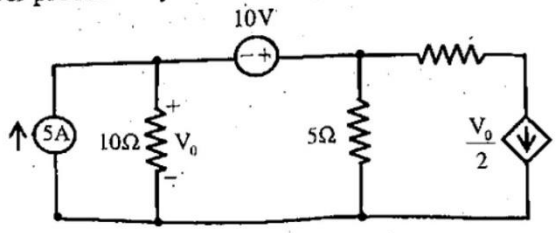


Fig.2.

Q.3 (a) Obtain the Fourier series of the waveform shown in Figure 3. (a)

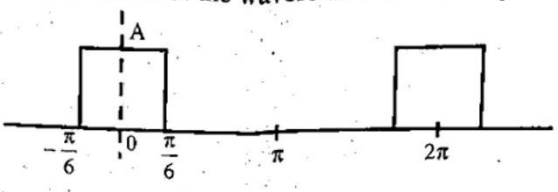


Fig. 3 (a)

(b) The phase currents in a star connected unbalanced load are $I_a = (44 - j33)$ Amps, $I_b = (-32 - j24)$ Amps, $I_c = (-40 + j25)$ Amps. Find the values of sequence currents.

Q.4 (a) A differential equation is represented by

$$\frac{d^2x}{dt^2} - x = e^{-t}$$

Assuming zero initial condition, find x (t) at $t > 0$.

(b) Find the final value of the following functions:

(i) $1 + e^{-2t}\cos 5t$

(ii) $2 - 2e^{-t}$

Q.5 (a) Design an m – derived low pass filter to match a line having characteristics impedance of 500Ω and to pass signals up to 1 kHz with infinite alternatives occurring at 1.2 kHz.

(b) Find an expression for the driving point impedance in s – domain for the reactive network shown in Figure 5(b).

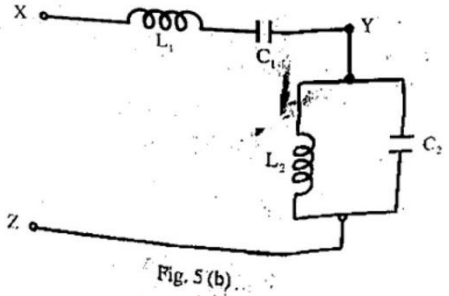


Fig. 5 (b)

Roll No. _____

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

First Mid Term Exam 2022

B.Tech. II Year III Semester Examination

***Subject: Network Theory* (3EC4-06)**

For ECE

Time: 2 Hr **Maximum Marks: 70**

Instructions to Candidates:

*Attempt **all ten questions** from **Part A,** and **any five questions** out of **seven** from **Part B.** (Schematic diagram must be shown wherever necessary). Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Part-A

*Answer should be given up to **25 words** only. (**All** questions are **compulsory**)*

(10x2=20)

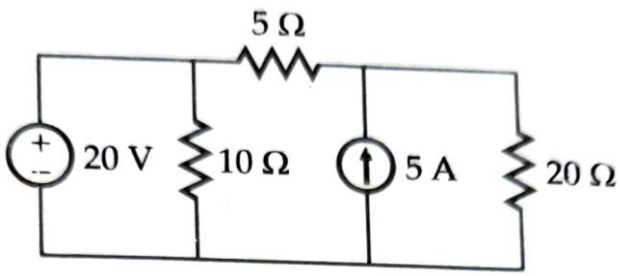
1. Define the node, junction and branch of electric circuit. **(CO1)**
2. Explain the source transformation and duality. **(CO1)**
3. What do you mean by passive element and active element? **(CO1)**
4. State the Kirchhoff's law. **(CO1)**
5. Write down the statement of superposition theorem. **(CO2)**
6. Explain the compensation theorem. **(CO2)**
7. Describe the condition of maximum power transfer in the electrical network. **(CO2)**
8. State Norton's theorem and also write the limitations. **(CO3)**
9. Express the fourier series coefficients. **(CO3)**
10. Represents wave of even, odd and half symmetry. **(CO3)**

Part-B

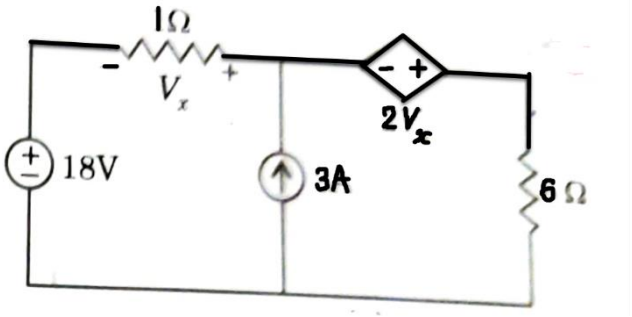
*Attempt **five** questions. (Analytical/Problems/Descriptive/Analytical/Problem Solving/Design Question solving questions)*

(5x10=50)

1 Determine the power loss across the 5 Ohm resistor **(CO1)**



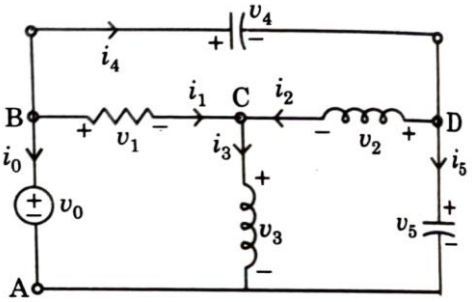
2. Calculate the current in the 6 Ohm resistor using Thevenin's theorem. **(CO1)**



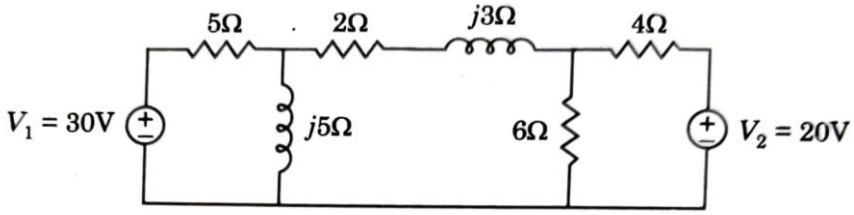
3. State and explain the maximum power transfer theorem and also derive the expression for the maximum power delivered to load. **(CO1)**

4. Verify Tellegen's theorem for the circuit shown in the figure below where the branch voltages and currents have the following values **(CO2)**

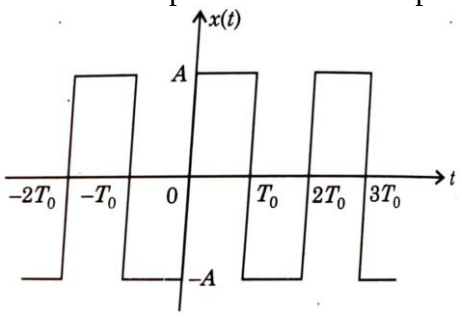
$v_0 = 40$ V, $v_1 = 32$ V, $v_2 = 4$ V,
$v_3 = 8$ V, $v_4 = 28$ V, $v_5 = 12$ V
$i_0 = -32$ A, $i_1 = 24$ A, $i_2 = 4$ A,
$i_3 = 28$ A, $i_4 = 8$ A, $i_5 = 4$ A.



5. Using Superposition theorem calculate the current through (2+3j) Ohm impedance of the circuit shown below **(CO2)**



6. Obtain the trigonomatric fourier series representation of the periodic signal as shown below **(CO3)**



7. Find the trigonometric fourier series for the waveform shown below **(CO3)**