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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech (Hons.) Degree Examination June 2024 (2022 Admission)

Course Code: EET292

Course Name: NETWORK ANALYSIS AND SYNTHESIS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1 Define the tree of a network and write the properties of a tree. (3)

2 Define twigs, co-tree, links or chords of a graph with example. (3)

3 Find the fundamental cutset matrix of the circuit shown in Fig. 1. (3)

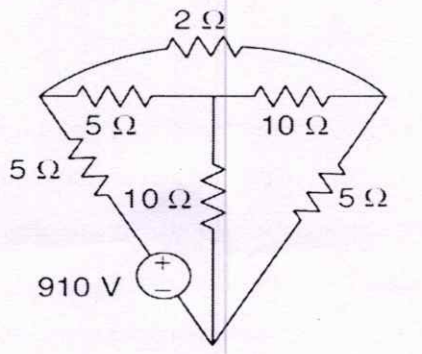

Figure 1: Figure for question 3.

4 State and verify Tellegen's theorem with the help of a suitable example. (3)

5 Derive an expression for the characteristic impedance of a symmetrical T-section. (3)

6 Draw and briefly explain the ideal characteristics of the low pass, high pass, band pass and band reject filters. (3)

7 Obtain the pole zero plot for $H(s) = \frac{\alpha}{(s+\alpha)}$. (3)

8 List the properties of a positive real function. (3)

9 Draw the Foster forms of the LC network. (3)

10 Write properties of the RL driving point immittance functions. (3)

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PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) For the circuit shown in Fig. 2, draw the oriented graph and write the (6)

(i) Incidence matrix and

(ii) Tieset matrix

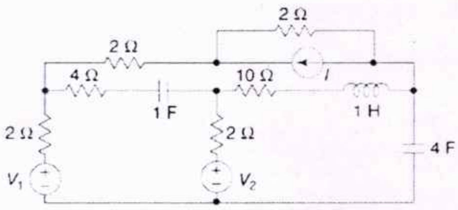

Figure 2: Figure for question 11 (a).

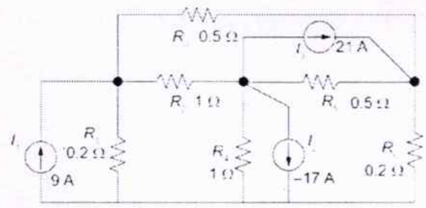

Figure 3: Figure for question 11 (b).

b) Determine the power delivered by each current source in the circuit in Fig. 3 by nodal analysis and apply network graph principles. (8)

12 a) The reduced incidence matrix of an oriented graph is given. (6)

(i) Draw the graph (ii) How many trees are possible for this graph? (iii) Write the tieset matrix.

$$A = \begin{bmatrix} 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \\ -1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

b) Find the node voltages in the circuit. Prepare the network graph with the reference direction for currents as marked in the Fig. 4. (8)

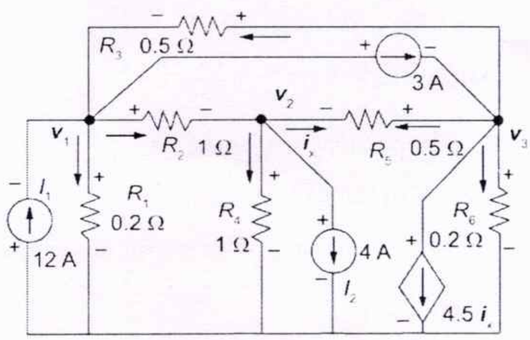

Figure 4: Figure for question 12 (b).

Module -2

13 a) What are dual graphs? Find the dual of the network shown in Fig. 5. (6)

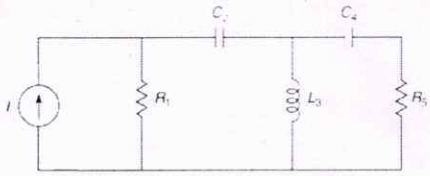

Figure 5: Figure for question 13 (a).

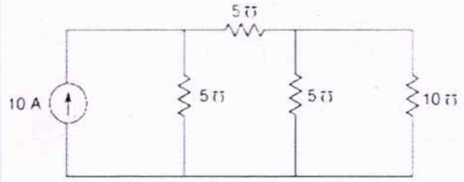

Figure 6: Figure for question 13 (b).

b) Find the voltage across each branch in the given network shown in Fig. 6 using node pair analysis. (8)

14 a) For the network shown in Fig. 7, write down the f-cutset matrix and obtain the twig voltages for the selected tree. (7)

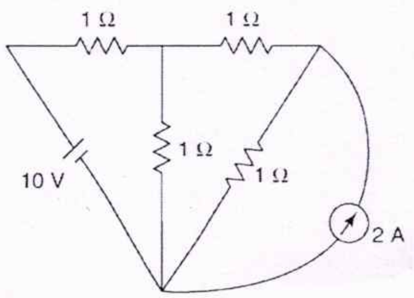

Figure 7: Figure for question 14 (a).

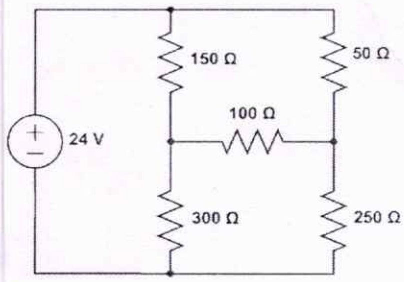

Figure 8: Figure for question 14 (b).

b) For the network shown in Fig. 8, find the branch currents and power delivered by the source in the following circuit using mesh analysis. (7)

Module -3

15 a) Design the T section of constant-k high pass filter having cut-off frequency of 15 kHz and nominal characteristic impedance $R_0 = 500\ \Omega$. Find characteristic impedance and phase constant at 25 kHz. Find attenuation at 12 kHz. (8)

b) Design the π-sectionof a m-derived low pass filter having cut-off frequency of 1 kHz, design impedance of 400 Ohms, and the resonant frequency 1100 Hz. (6)

16 a) Design a constant-k band pass filter (T-section) having cut-off frequencies 1kHz and 10 kHz and nominal characteristic impedance of 500 Ω. (9)

b) Design a π -type attenuator required to reduce the level of an audio signal by 20 dB while matching the impedance of the 100Ω network. (5)

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Module -4

17 a) Draw the pole zero diagram of given network function and hence obtain time domain response (6)

$$V(s) = \frac{2s^2 + 80s + 1000}{s\,(s+1)(s+30)}$$

b) Determine the range of value of K so that the given polynomial P(s) is Hurwitz polynomial (8)

$$P(s) = s^4 + s^3 + Ks^2 + 2s + 3$$

18 a) Test whether the following polynomials are Hurwitz polynomials or not. (6)

i. $s^4 + s^3 + 3s^2 + 2s + 12$

ii. $s^5 + 3s^3 + 2s$

iii. $s^6 + 2s^5 + 2s^4 + 3s^3 + 5s^2 + 6s + 1$

b) i. Test whether $F(s) = \frac{s^2+6s+5}{s^2+s+14}$ is positive real function. (8)

ii. Test whether $F(s) = \frac{s^4+4}{s^3+3s^2+3s+1}$ is positive real function.

Module -5

19 a) Realise the Foster and Cauer forms of the given impedance function. (14)

$$Z(s) = \frac{4\,(s^2+1)(s^2+9)}{s(s^2+4)}$$

20 a) Realise the following RL impedance function in Foster-I and Foster-II forms. (10)

$$Z(s) = \frac{2\,(s+1)(s+3)}{(s+2)(s+6)}$$

b) Check whether the following function is a RC impedance function or not. (4)

$$Z(s) = \frac{3\,(s+2)(s+4)}{s\,(s+3)}$$