DEPARTMENT OF ELECTRICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR, JHARKHAND

Mid-Semester Exam, Autumn 2024-2025

B Tech, 3rd SEM — **Subject:** Electrical Circuits and System, **Code:** EE1304
Date: 08/10/2024, A-Shift — **Course Instructors:** Dr. K. Raghavendra Naik
Time: 8.30AM-10.30AM — **Max. Marks:** 30

Instructions:

1. Answer all the questions.
2. Allocate the time to answer each question based on the marks assigned.

Q1. (a) Consider a star connection of resistors and its equivalent delta connection as shown in Fig. 1. If the all the elements (R_A, R_B, R_C) of the star connection are scaled by a factor $\frac{1}{z}$ $(z > 0)$then the corresponding equivalent elements of the delta connection (R_a, R_b, R_c) are scaled by what factor? [3M]

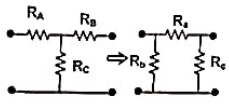

Fig. 1

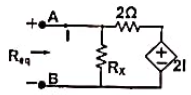

Fig. 2

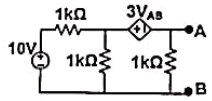

Fig. 3

(b) The equivalent resistance R_{eq} for the circuit shown in Fig. 2 is found to be $\frac{8}{3}\Omega$. What value of $R_X(\Omega)$ ensures the calculated $R_{eq}\left(=\frac{8}{3}\Omega\right)$ value. [3M]

(c) Name two real time electrical applications where network theorems can be applied. [2M]

(d) For the circuit shown in Fig. 3 find V_{AB} and Thevenin's equivalent resistance. Provide the solution step by step. [4M]

Q2. (a) For the circuit shown in Fig. 4, thevenin's resistance is found to be 10kΩ and the open circuit voltage looking from terminal A, B is 8V. Considering this data, find the values of R_1 and R_2. [5M]

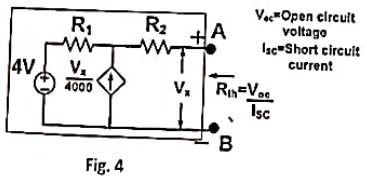

Fig. 4

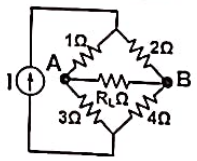

Fig. 5

(b) The maximum power transferred to the load resistance in Fig. 5 is (40/21) watts. What value of the source current has led to the aforementioned maximum power? [4M]

(c) Keeping the thevenin's resistance calculated in the above case as constant, if it is required to increase the maximum power to (60/21) watts then how much additional source current is required to deliver this maximum power? [2M]

Q3. (a) A magnifier circuit's frequency analysis plot is shown in Fig. 6 The bandwidth of this plot is $(0.2/\pi)$kHZ. With this data, name the magnifier circuit and drew its circuit diagram. Find the magnitude of the current flowing through capacitance with the given circuit data. The resistance, inductance and capacitance of the magnifier circuit are 10 Ω, 5mH and 50μF respectively. The supply voltage and frequency of the magnifier circuit is 100V, 50Hz. [4M]

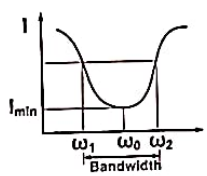

Fig. 6

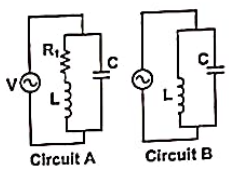

Fig. 7

(b) In Fig 7 the resonant frequencies obtained for circuit A and circuits B are 10rad/sec and 12rad/sec respectively. Based on the given resonant frequencies find the band width of circuit A. [3M]

Note: The value of Band width of circuit A can be expressed as $\frac{R_1}{L}$

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End-Semester Exam, Autumn 2024-2025

B Tech, 3rd SEM, ECE — **Subject:** Electrical Circuits and System, **Code:** EE1304
Date: 06/12/2024, B-Shift — **Course Instructors:** Dr. K. Raghavendra Naik
Time: 2PM-5PM — **Max. Marks:** 50

Instructions:

1. It is suggested to write answers for subparts of a specified question in order.
2. Allocate the time to answer each question based on the marks assigned.

Q1. (a) With supportive derivations provide the reciprocity and symmetrical conditions for ABCD parameters. [4M]

(b) Find the ABCD parameters for the network shown in Fig. 1. [4M]

(c) Find the Z- parameters for the network shown in the Fig.2 [4M]

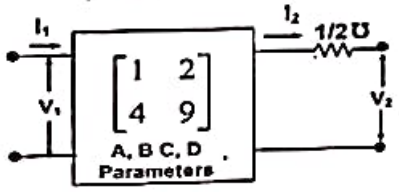

Fig. 1

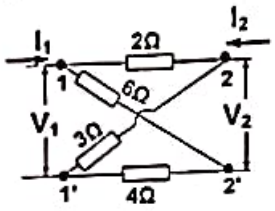

Fig. 2

(d) Find the Y- parameters for the network shown in the Fig.3 [4M]

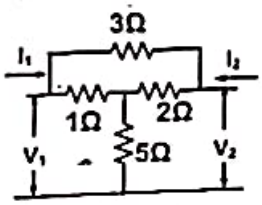

Fig. 3

Q2. (a) A networks transfer function (TF) is given as follows. Using the knowledge of Hurwitz polynomial comment on the stability of $TF = \dfrac{(s+1)}{s^6+10s^5+9s^3+5s^2+2s+7}$. [4M]

(b) To synthesize a stable TF deduced from a network configuration, what essential conditions/rules should it satisfy with reference to Hurwitz polynomial criterion? [2M]

(c) Provide the assessment of the following TF. Can this TF be physically realized with LC Immittance function (YES/NO)? Provide the mathematical reasoning to support your YES/NO response. [3M]

$$TF = \frac{(s^2+4)(s^2+16)(s^2+36)}{(s^2+1)(s^2+9)(s^2+25)(s^2+20)}$$

(d) Provide the synthesis for the given network's TF using Cauer first form of network realization. Also comment on the stability of this network. [6M]

$$TF = \frac{4s^7+21s^5+23s^3+6s}{4s^6+17s^4+14s^2+2}$$

Q3. (a) With supportive mathematical analysis, Identify which type of filter each transfer function represents? [4M]

(i) $TF = \frac{s^2+5}{s^2+3s+5}$ (ii) $TF = \frac{s}{s^2+3s+1}$

(b) What is the maximum phase shift introduced onto the input signal of first order low pass RC filter? [2M]

(c) Considering the response of the network shown in Fig. 4 is $\frac{V_0(s)}{V_i(s)} = \frac{9}{s^2+6s+9}$. What are the elements this network. Find each element values. Hint: One of the elements of this network is Inductor whose value is (1/3H). [4M]

Q4. (a) Find the RMS and average values for the voltage wave form shown in Fig. 5 [4M]

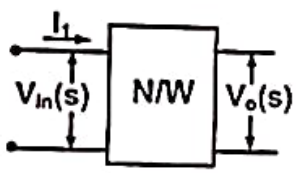

Fig.4

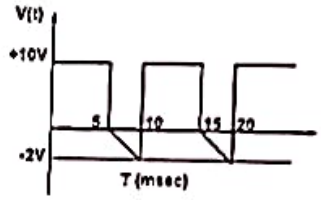

Fig.5

(b) Drew a phasor diagram ensuring the phasor relation among all the variables of the network given in Fig. 6 [3M]

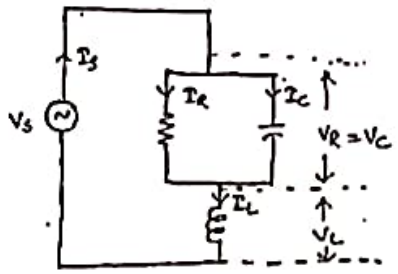

Fig.6

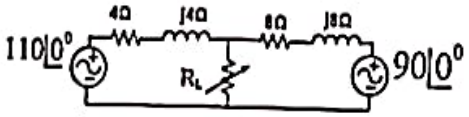

Fig.7

(c) Find how much maximum power can be transferred to the load resistance shown in Fig.7 [4M]

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