Sol. Set

Date: 15th Feb 2019

Indian Institute of Information Technology, Sri City, Chittoor

Name of the Exam: Basic Electronic Circuits   Duration: 90 Mins.   Max. Marks: 15

Roll No.:__________ Room No.: __________ Seat No.: __________

Invigilator's Signature: __________

	Q1	Q2	Q3	Q4	Q5	Total
Max. Marks	2	2	4	4	3	
Marks obtained						

Instructions:

1. It's a closed book exam, no formula sheets, no text books, no hand written notes.
2. Mobile phones, and other smart gadgets are strictly not allowed, if anyone found with such items will be sent out of the examination hall and zero marks will be awarded.
3. Scientific calculator is allowed, but exchange of the same during the exam is strictly not allowed.
4. Answers written with pencil will not be evaluated.
5. You must write the answers in a clean and neat manner in the space provided.
6. No additional sheets will be provided.

Q1. (a) Determine the resistance of a circular bar of length 10 m and diameter $\frac{4}{\sqrt{\pi}}$ m, which is made of a composite material having conductivity σ = 0.25 milli S/m. (1 Mark)

$R = \frac{l}{\sigma A}$ $l = 10\,m$, $D = \frac{4}{\sqrt{\pi}}$; $r = \frac{2}{\sqrt{\pi}}$

$A = \pi r^2 = 4$ $\sigma = 0.25 \times 10^{-3}$

$R = \frac{10}{0.25 \times 10^{-3} \times 4} = \underline{10\,k\Omega}$

(b) If this composite bar is connected across the terminals A and B as shown in Fig. 1, determine the current through the composite bar. (1 Mark)

$I = \frac{6}{3 + (4 \| 12)} = \frac{6}{6} = 1\,mA$

$I_{10k\Omega} = 0.25\,mA$

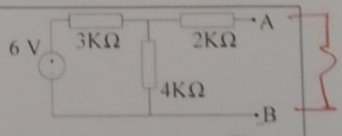

Fig. 1.

$\frac{4 \times 12}{16} = 3$

Q2. If the hybrid parameters of a two-port network shown in Fig. 2 are, $h_{11} = 3\ \Omega$; $h_{12} = 2/3$; $h_{21} = -2/3$; and $h_{22} = 1/9$ S. Determine the values of R_1, R_2, and R_3. (2 Marks)

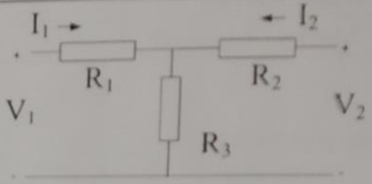

Fig. 2.

$$h_{11} = \left.\frac{V_1}{I_1}\right|_{V_2=0} = R_1 + \frac{R_2 R_3}{R_2+R_3} = 3 \quad -(1)$$

$$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0} = -\frac{R_3}{R_2+R_3} = -\frac{2}{3} \quad -(2)$$

$$V_1 = h_{11} I_1 + h_{12} V_2$$

$$I_2 = h_{21} I_1 + h_{22} V_2$$

$$h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1=0} = \frac{R_2}{R_2+R_3} = 2/3 \quad (3)$$

$$h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1=0} = \frac{1}{R_2+R_3} = \frac{1}{9} \quad (4)$$

from (4)

$R_2+R_3 = 9$; from (3) $R_3 = \frac{2}{\cancel{3}} \times \cancel{9}^{3} = 6\ \Omega$

$R_2 = 3\ \Omega$; $R_1 = 1\ \Omega$.

Rough work:

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Q3. Determine the maximum power that can be delivered to the load resistance 'R_L' for the circuit shown in Fig. 3, note that, the transmission parameters of the two-port network are,

$A = 3/2$; $B = 11/2\ \Omega$; $C = 1/2$ S; and $D = 5/2$. (4 Marks)

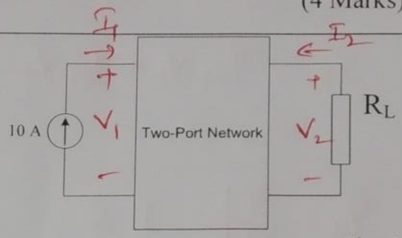


Fig. 3.

$$V_1 = \frac{3}{2} V_2 - \frac{11}{2} I_2 \rightarrow (1)$$

$$I_1 = \frac{1}{2} V_2 - \frac{5}{2} I_2 \rightarrow (2)$$

from Fig.

$$\boxed{I_1 = 10\ A}$$

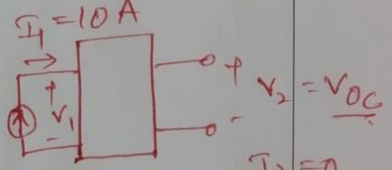
$$\boxed{I_2 = -\frac{V_2}{R_L}}$$

open R_L to obtain Thevenin's equivalent

for $V_2 = V_{oc}$; $I_2 = 0$

(2.)

$$V_2 = 2 I_1 = 20\ V = V_{oc}$$

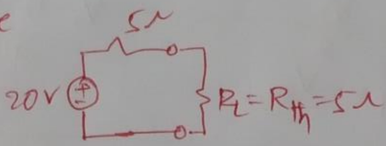


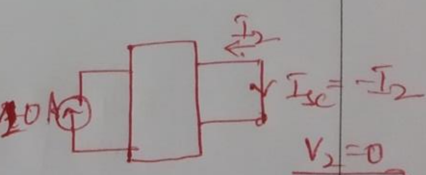
for $V_2 = 0$; $I_{sc} = -I_2$

$$I_1 = -\frac{5}{2} I_2 = \frac{5}{2} I_{sc}$$

$$I_{sc} = \frac{2}{5} \cancel{10}^{\,2} = 4\ A$$

$$R_{th} = \frac{V_{oc}}{I_{sc}} = 5\ \Omega$$





Rough Work:

$$P_{R_L} = \frac{V_{R_L}^2}{R_L} = \frac{100}{5} = 20\ \text{Watts}$$

Q4. Determine the Y-parameters of the network shown in Fig. 4. (4 Marks)

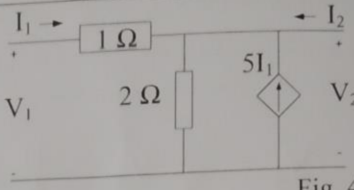


Fig. 4.

$I_1 = Y_{11} V_1 + Y_{12} V_2$

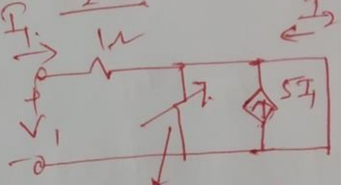
$I_2 = Y_{21} V_1 + Y_{22} V_2$

$Y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} = 1\ S$

$Y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0} = \frac{-6 I_1}{V_1}$

$= -6\ S$

(i) $V_2 = 0$



remove (due to short circuit)

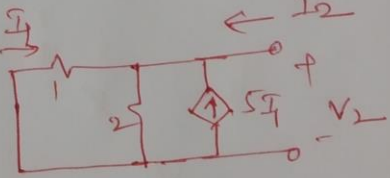
$6 I_1 + I_2 = 0$

$I_2 = -6 I_1$

$Y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0} = -1\ S$

$Y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0} = 6.5\ S$

(ii) $V_1 = 0$



$6 I_1 + I_2 = \frac{V_2}{2}$

using $I_1 = -V_2$

V_2 is the voltage drop across both 1Ω, 2Ω resistors

Rough Work:

$-6 V_2 + I_2 = \frac{V_2}{2}$

$\boxed{I_1 = -V_2}$

$I_2 = 6.5\, V_2 \rightarrow \frac{I_2}{V_2} = 6.5$

. Obtain the Thevenin's equivalent of the circuit shown in Fig. 5. (3 Marks)

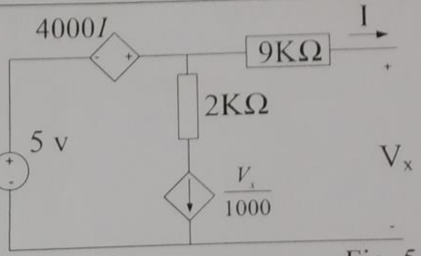
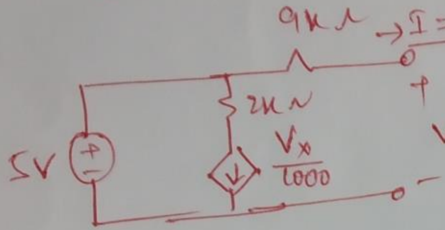


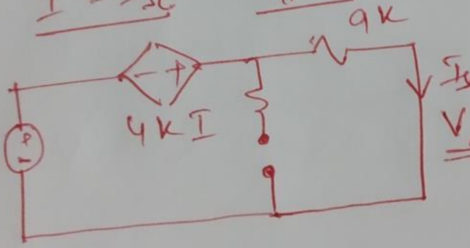
Fig. 5.

(i) $\underline{V_{oc} = V_x}$: $\underline{I = 0}$.



$V_{oc} = \underline{5V}$.

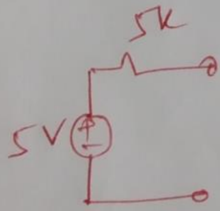
(ii) $\underline{I = I_{sc}}$ $\underline{V_x = 0}$



$\underline{V_x = 0}$

$5 + 4k I_{sc} = 9k I_{sc}$.

$$I_{sc} = \frac{5}{9k-4k} = \frac{5}{5k} = 1mA.$$



$$R_{th} = \frac{5}{1mA} = \underline{5k}$$

Rough Work: