GOVERNMENT POLYTECHNIC COLLEGE BHILWARA

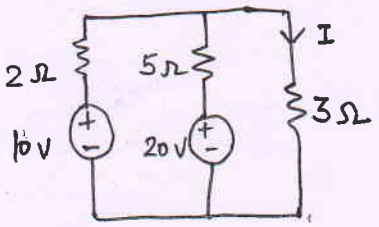
II MID TERM: 14th February 2018

II- Year Electronics **Maximum Marks: 15**

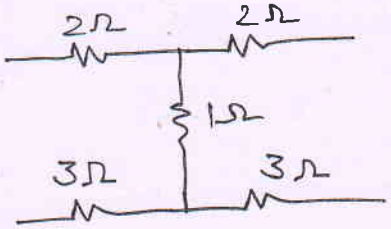
EL- 202 Circuit Theory

All Questions are compulsory/. सभी प्रश्न अनिवार्य हैं

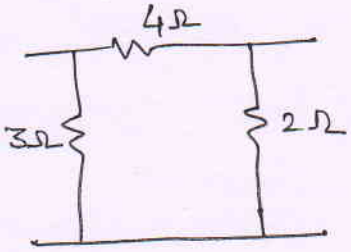
1. Define Tellegen's Theorem with an example/Tellegen के प्रमेय को उदाहरण के साथ स्पष्ट कीजिये [3 marks]
2. Calculate the current I in the circuit using Millman Theorem/ निम्नलिखित परिपथ में Millman प्रमेय की मदद से धारा I को ज्ञात कीजिये [3 marks]



3. Calculate all the Z parameters for the given circuit/ दिए गए परिपथ में सभी Z प्राचल ज्ञात कीजिये [3 marks]



4. Calculate all the Y parameter for the given circuit / दिए गए परिपथ में सभी Y प्राचल ज्ञात कीजिये [3 marks]



5. Calculate the value of h_{11} and h_{21} in terms of Z parameters / प्रचाल h_{11} एवं h_{21} को Z प्रचाल के रूप में ज्ञात कीजिये [3 marks]

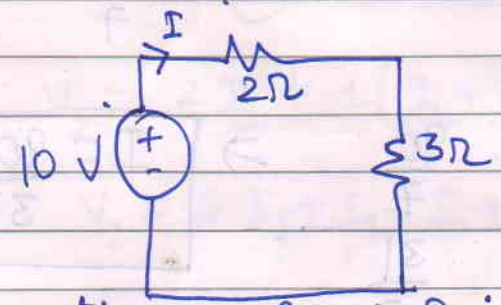
II- Mid Term (Electronics)
EL-202 (Circuit Theory)

① Tellegen's Theorem

According to this theorem the sum of the powers developed (delivered + absorbed) is zero at all instants of time.

This theorem is applicable irrespective of the fact whether the circuit is linear or non-linear, time variant or time invariant, causal or non causal.

eg



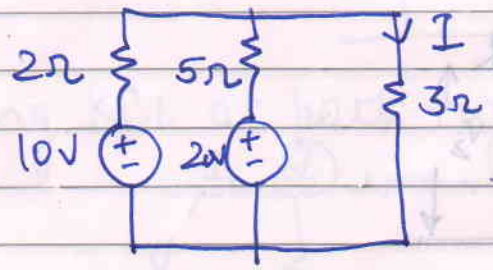
Calculating the current I in the circuit $I = \frac{10}{5} = 2$ Amp

Power delivered $P_D = -(10\,V \times 2\,Amp) = -20$ Watts

Power absorbed $P_A = (2\Omega)^2 \times 2\,Amp + (2)^2(3) = +20$ Watts

Total power $P = P_D + P_A = +20 - 20 = \boxed{0 \text{ Watts}}$

② Given circuit



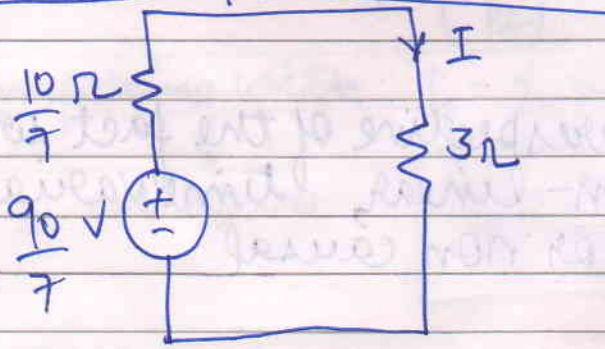
$G_1 = 0.5\,\mho$ $G_2 = 0.2\,\mho$ $V_1 = 10\,V$ $V_2 = 20\,V$

$$V_\eta = \frac{V_1 G_1 + V_2 G_2}{G_1 + G_2} = \frac{(10)(0.5) + (20)(0.2)}{0.7}$$

$$V_\eta = \frac{5+4}{0.7} = \boxed{\frac{90}{7} \text{ volts}}$$

$$R_\eta = \frac{1}{G_1 + G_2} = \boxed{\frac{10}{7}\ \Omega}$$

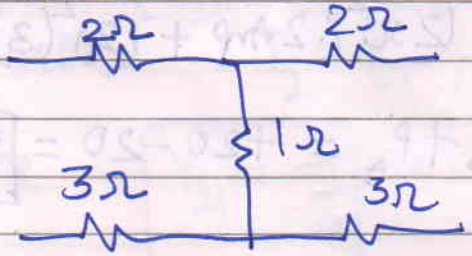
Millman's equivalent circuit



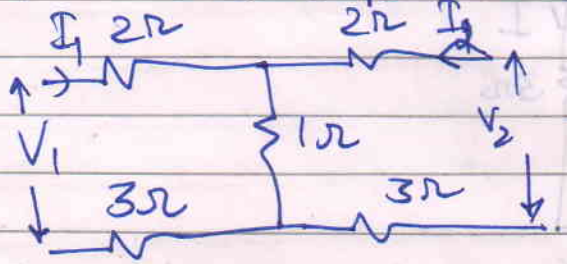
$$I = \frac{\frac{90}{7}}{\frac{10}{7}+3}$$

$$I = \frac{\frac{90}{7}}{\frac{31}{7}} \Rightarrow \boxed{I = \frac{90}{31} \text{ Amp}}$$

(3) Given circuit



using KVL in both loops



$$V_1 = 2I_1 + 1(I_1 + I_2) + 3I_1$$

$$V_1 = 2I_1 + I_1 + I_2 + 3I_1$$

$$\text{or} \quad V_1 = 6I_1 + I_2$$

comparing with $V_1 = Z_{11}I_1 + Z_{12}I_2$

we have $\boxed{Z_{11} = 6\Omega}$ $\boxed{Z_{12} = 1\Omega}$

using KVL in loop (2)

$$V_2 = 2I_2 + 1(I_1 + I_2) + 3I_2$$

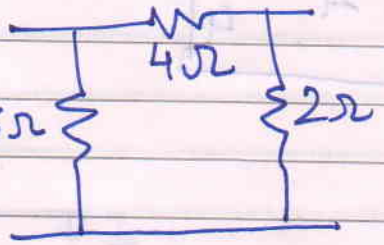
$$V_2 = 2I_2 + I_1 + I_2 + 3I_2$$

$$V_2 = I_1 + 6I_2$$

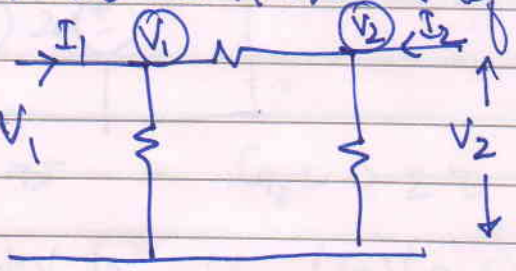
comparing with $V_2 = Z_{21}I_1 + Z_{22}I_2$

we have $\boxed{Z_{21} = 1\Omega}$ $\boxed{Z_{22} = 6\Omega}$

(4) Given circuit



applying KCL at both nodes of the circuit



For node 1:

$$I_1 = \frac{V_1}{3} + \frac{V_1 - V_2}{4}$$

Or $$I_1 = V_1\left(\frac{1}{3} + \frac{1}{4}\right) - \frac{V_2}{4}$$

$$\Rightarrow I_1 = \left(\frac{7}{12}\right)V_1 + \left(\frac{-1}{4}\right)V_2$$

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

we have $\boxed{Y_{11} = \frac{7}{12}\,\upsilon}$ $\boxed{Y_{12} = \frac{-1}{4}\,\upsilon}$

For node 2:

$$I_2 = \frac{V_2}{2} + \frac{V_2 - V_1}{4}$$

$$I_2 = \frac{-V_1}{4} + V_2\left(\frac{1}{2} + \frac{1}{4}\right)$$

$$I_2 = \left(\frac{-1}{4}\right)V_1 + \left(\frac{3}{4}\right)V_2$$

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

we have $\boxed{Y_{21} = \frac{-1}{4}\,\upsilon}$ $\boxed{Y_{22} = \frac{3}{4}\,\upsilon}$

⑤ h-parameters

$$V_1 = h_{11} i_1 + h_{12} V_2 \quad \text{①}$$

$$I_2 = h_{21} I_1 + h_{22} V_2 \quad \text{②}$$

Z parameters.

$$V_1 = z_{11} I_1 + z_{12} I_2 \quad \text{③}$$

$$V_2 = z_{21} I_1 + z_{22} I_2 \quad \text{④}$$

using eq^n ③ to calculate I_2

$$I_2 = \frac{V_1 - z_{11} I_1}{z_{12}}$$

using in eq^n ④

$$V_2 = z_{21} I_1 + z_{22}\left(\frac{V_1 - z_{11} I_1}{z_{12}}\right)$$

$$z_{12} V_2 = z_{12} z_{21} I_1 + z_{22} V_1 - z_{11} z_{22} I_1$$

$$\text{or} \quad z_{22} V_1 = (z_{11} z_{22} - z_{12} z_{21}) I_1 - z_{12} V_2$$

$$\text{or} \quad V_1 = \left(\frac{\Delta z}{z_{22}}\right) I_1 + \left(\frac{-z_{12}}{z_{22}}\right) V_2$$

Comparing with eq^n ①

$$\boxed{h_{11} = \frac{\Delta z}{z_{22}}}$$

(P. D. Upadhyay)
Electronics