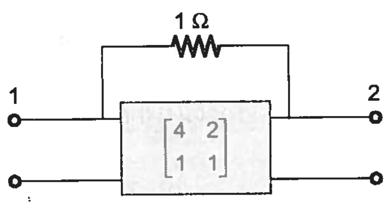
6 Two-Port Networks

Multiple Choice Questions

Q.1 The Y parameters of a four-terminal block are $\begin{bmatrix} 4 & 2 \\ 1 & 1 \end{bmatrix}$. A single element of 1 ohm is connected across as shown in the given figure. The new Y parameters will be



(a) $\begin{bmatrix} 5 & 1 \\ 0 & 2 \end{bmatrix}$ (b) $\begin{bmatrix} 4 & 3 \\ 2 & 2 \end{bmatrix}$

(c) $\begin{bmatrix} 3 & 2 \\ 1 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} 4 & 2 \\ 1 & 1 \end{bmatrix}$

[ESE-1994]

Q.2 With the usual notation, a two-port resistive network satisfies the condition

$$A = D = \frac{3}{2}B = \frac{4}{3}C$$

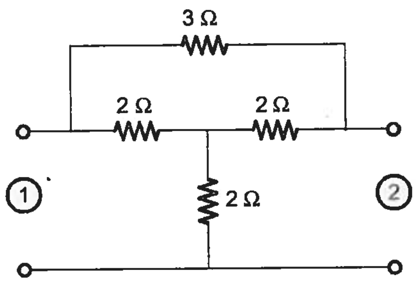
The Z_{11} of the network is

(a) 5/3 (b) 4/3

(c) 2/3 (d) 1/3

[ESE-1995]

Q.3 The Y_{21} parameter of the network shown in the given figure will be



(a) $\frac{1}{6}$mho (b) $-\frac{1}{6}$mho

(c) $\frac{1}{3}$mho (d) $-\frac{1}{2}$mho

[ESE-1996]

Q.4 The short-circuit admittance matrix of a two-port network is

$$\begin{bmatrix} 0 & -1/2 \\ 1/2 & 0 \end{bmatrix}$$

The two – port network is

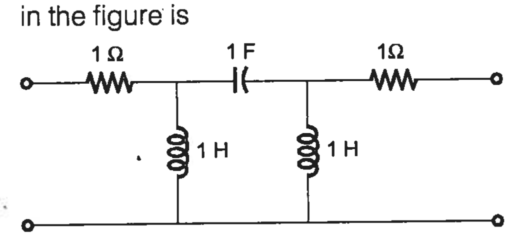
(a) non – reciprocal and passive

(b) non – reciprocal and active

(c) reciprocal and passive

(d) reciprocal and active [GATE-1998]

Q.5 Driving-point impedance of the network shown in the figure is

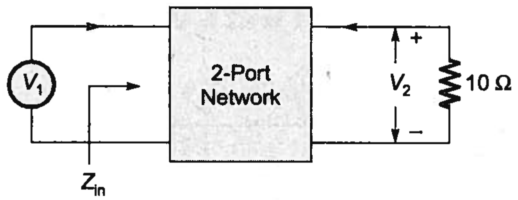


(a) $\dfrac{s^3 + 2s^2 + s + 1}{2s^2 + 1}$ (b) $\dfrac{s^3 + s^2 + s + 1}{s^2 + 1}$

(c) $\dfrac{2s^2 + 1}{s^3 + 2s^2 + s + 1}$ (d) $\dfrac{s^3 + 2s^2 + s + 1}{s^2 + 1}$

[ESE-1999]

Q.6 If the transmission parameters of the above network are $A = C = 1$, $B = 2$ and $D = 3$, then the value of Z_{in} is



(a) $\frac{12}{13}\,\Omega$ (b) $\frac{13}{12}\,\Omega$

(c) $\frac{8}{7}\,\Omega$ (d) $4\,\Omega$

[ESE-2000]

Q.7 The impedance matrices of two, two-port networks are given by

$$\begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix} \text{ and } \begin{bmatrix} 15 & 5 \\ 5 & 25 \end{bmatrix}$$

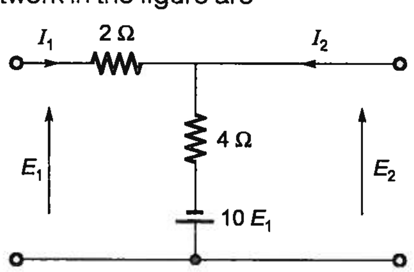
If these two networks are connected in series, the impedance matrix of the resulting two-port network will be

(a) $\begin{bmatrix} 3 & 5 \\ 2 & 25 \end{bmatrix}$ (b) $\begin{bmatrix} 18 & 7 \\ 7 & 28 \end{bmatrix}$

(c) $\begin{bmatrix} 15 & 2 \\ 5 & 3 \end{bmatrix}$ (d) indeterminate

[ESE-2000]

Q.8 The z parameters z_{11} and z_{21} for the 2-port network in the figure are



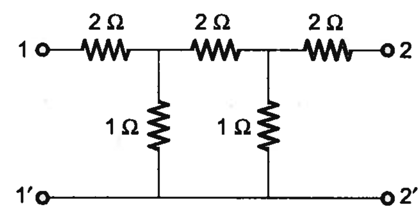
(a) $z_{11} = \frac{-6}{11}\Omega;\ z_{21} = \frac{16}{11}\Omega$

(b) $z_{11} = \frac{6}{11}\Omega;\ z_{21} = \frac{4}{11}\Omega$

(c) $z_{11} = \frac{6}{11}\Omega;\ z_{21} = \frac{-16}{11}\Omega$

(d) $z_{11} = \frac{4}{11}\Omega;\ z_{21} = \frac{4}{11}\Omega$ [GATE-2001]

Q.9 The impedance parameters z_{11} and z_{12} of the two-port network in the figure are



(a) $z_{11} = 2.75\,\Omega$ and $z_{12} = 0.25\,\Omega$

(b) $z_{11} = 3\,\Omega$ and $z_{12} = 0.5\,\Omega$

(c) $z_{11} = 3\,\Omega$ and $z_{12} = 0.25\,\Omega$

(d) $z_{11} = 2.25\,\Omega$ and $z_{12} = 0.5\,\Omega$

[GATE-2001]

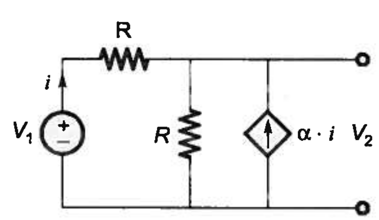
Q.10 The driving point impedance $Z(s) = \frac{s+2}{s+3}$. The system is initially at rest. For a voltage signal of unit step, the current $i(t)$ through the impedance Z is given by

(a) $2 - e^{-t}$ (b) $3/2 - 1/2\, e^{-3t}$

(c) $3/2 - 1/2\, e^{-2t}$ (d) $3 - 2\, e^{-2t}$

[ESE-2001]

Q.11 Consider the circuit as shown below which has a current-dependent current source. The value V_2/V_1 is

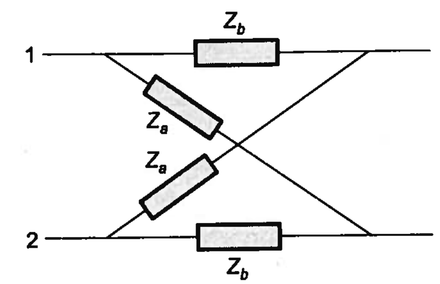


(a) 1 (b) 2

(c) $\frac{1+\alpha}{2+\alpha}$ (d) $\frac{\alpha}{2+\alpha}$

[ESE-2003]

Q.12 For the lattice circuit shown in the figure, $Z_a = j2\,\Omega$ and $Z_b = 2\Omega$. The values of the open circuit impedance parameters $Z = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix}$ are



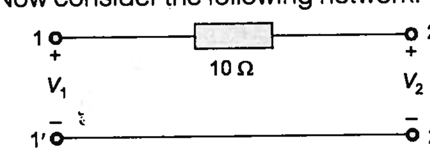
(a) $\begin{bmatrix} 1-j & 1+j \\ 1+j & 1+j \end{bmatrix}$ (b) $\begin{bmatrix} 1-j & 1+j \\ -1+j & 1-j \end{bmatrix}$

(c) $\begin{bmatrix} 1+j & 1+j \\ 1+j & 1-j \end{bmatrix}$ (d) $\begin{bmatrix} 1+j & -1+j \\ -1+j & 1+j \end{bmatrix}$

[GATE-2003]

Q.13 The input voltage V_1 and current I_1 for linear passive network is given by $V_1 = AV_2 - BI_2$ and $I_1 = CV_2 - DI_z$

Now consider the following network:



Which one of the following is the transfer matrix $\begin{bmatrix} A & B \\ C & D \end{bmatrix}$ of the network shown above?

(a) $\begin{bmatrix} 1 & 0 \\ 0 & 10 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 10 \\ 0 & 1 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & 1 \\ 10 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 0 & 10 \\ 1 & 0 \end{bmatrix}$

[ESE-2004]

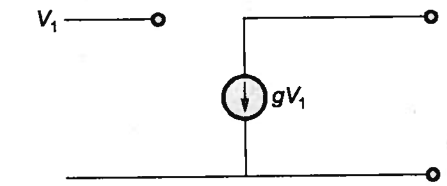
Q.14 For an ideal step-down (n : 1) transformer, which one of the following is the ABCD parameter matrix?

(a) $\begin{bmatrix} n & 1 \\ 1 & n \end{bmatrix}$ (b) $\begin{bmatrix} n & 0 \\ 0 & n \end{bmatrix}$

(c) $\begin{bmatrix} n & 0 \\ 0 & 1/n \end{bmatrix}$ (d) $\begin{bmatrix} n & 1/n \\ 1/n & 1 \end{bmatrix}$

[ESE-2004]

Q.15 The 2-port network shown in the circuit given below is connected in parallel with another 2-port network which has $y_{11} = y_{22} = -y_{12} = -y_{21} = Y$.



The y-parameters of the composite network will satisfy which one of the following?

(a) $y_{11} = Y + g$ (b) $y_{12} = -Y + g$

(c) $y_{21} = -Y + g$ (d) $y_{22} = Y + g$

[ESE-2004]

Q.16 In the case of ABCD parameters, if all the impedances in the network are doubled, then

(a) A and D remain unchanged, C is halved and B is doubled

(b) A, B, C and D are doubled

(c) A and B are doubled, C and D are unchanged

(d) A and D are unchanged, C is doubled and B is halved

[ESE-2010]

Q.17 The h_{11} and h_{22} of a standard T-network with series impedances 2 Ω and 7 Ω, and shunt branch impedance of 3 Ω are

(a) 5 Ω and 10 mho respectively

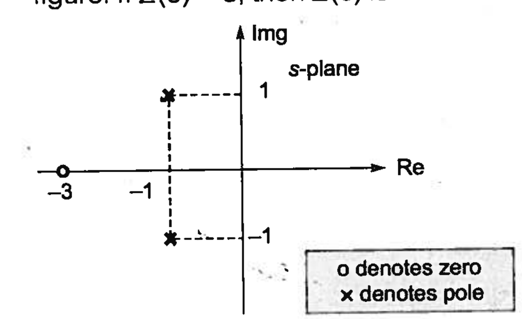
(b) 10 Ω and 5 mho respectively

(c) 4.1 Ω and 0.1 mho respectively

(d) 10 Ω and 0.2 mho respectively

[ESE-2012]

Q.18 The driving-point impedance $Z(s)$ of a network has the pole-zero locations are shown in the figure. If $Z(0) = 3$, then $Z(s)$ is

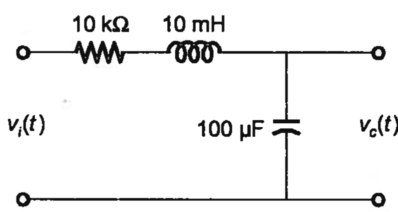


(a) $\frac{3(s-3)}{s^2+2s+3}$ (b) $\frac{2(s+3)}{s^2+2s+2}$

(c) $\frac{3(s-3)}{s^2-2s-2}$ (d) $\frac{2(s-3)}{s^2-2s-3}$

[GATE-2003]

Q.19 For the circuit shown in the figure, the initial conditions are zero. Its transfer function $H(s)=\frac{V_c(s)}{V_i(s)}$ is

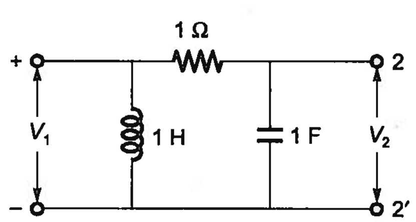


(a) $\frac{1}{s^2+10^6s+10^6}$ (b) $\frac{10^6}{s^2+10^3s+10^6}$

(c) $\frac{10^3}{s^2+10^3s+10^6}$ (d) $\frac{10^6}{s^2+10^6s+10^6}$

[GATE-2004]

Q.20 For the network shown below.



Match **List-I** (y-parameter) with **List-II** (Value) and select the correct answer using the code given below the lists:

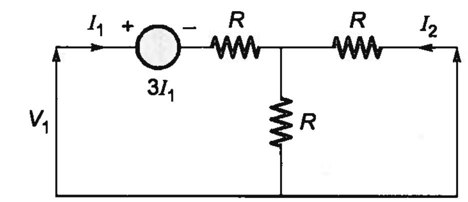
List-I	List-II
A. y_{11}	1. $s+1$
B. y_{12}	2. -1
C. $y_{22}+y_{21}$	3. $1+1/s$
D. y_{22}	4. s

Codes:

	A	B	C	D
(a)	3	2	4	1
(b)	1	4	2	3
(c)	3	4	2	1
(d)	1	2	4	3

[ESE-2005]

Q.21 Which one of the following is correct? The circuit shown in the figure below.



(a) is reciprocal but not symmetrical
(b) is not reciprocal but symmetrical
(c) is both reciprocal and symmetrical
(d) is neither reciprocal nor symmetrical

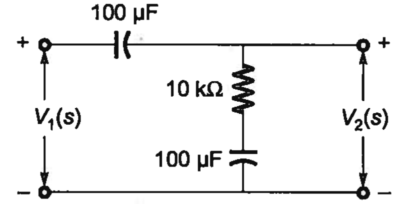
[ESE-2007]

Q.22 A two-terminal network consists of a coil having inductance L and resistance R shunted by a capacitance C. The poles and zeros of the driving-point impedance function $Z(\omega)$ are located as poles at $-\frac{1}{2}\pm j\frac{\sqrt{3}}{2}$ and zero at -1.

If $Z(0)=1$, the values of R, L and C are
(a) 1 Ω, 1 H and 1 μF
(b) 1 Ω, 1 H and 1 F
(c) 1 Ω, 1 μH and 1 F
(d) 1 kΩ, 1 H and 1 F

[ESE-2012]

Q.23 The transfer function $\frac{V_2(s)}{V_1(s)}$ of the circuit shown below is



(a) $\frac{0.5s+1}{s+1}$ (b) $\frac{3s+6}{s+2}$

(c) $\frac{s+2}{s+1}$ (d) $\frac{s+1}{s+2}$

[GATE-2013]

Q.24 Two 2-port networks with transmission matrices

$$T_A=\begin{bmatrix}1 & 2\\ 0.1 & 4\end{bmatrix} \text{ and } T_B=\begin{bmatrix}2 & 4\\ 0.5 & 3\end{bmatrix}$$

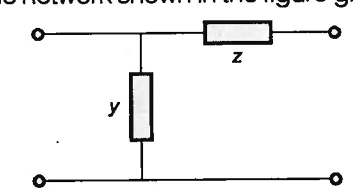
are connected in cascade. Which is the transmission matrix of the combination?

(a) $\begin{bmatrix}3 & 10\\ 2.2 & 12.4\end{bmatrix}$ (b) $\begin{bmatrix}3 & 6\\ 0.2 & 12.4\end{bmatrix}$

(c) $\begin{bmatrix}1 & 10\\ 2.0 & 12.0\end{bmatrix}$ (d) $\begin{bmatrix}3 & 10\\ 12.4 & 2.2\end{bmatrix}$

[ESE-2006]

Q.25 Which one of the following is the transmission matrix for the network shown in the figure given below?

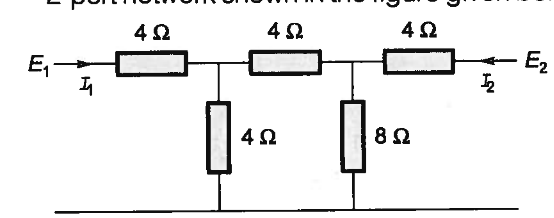


(a) $\begin{bmatrix}1 & 1+yz\\ y & z\end{bmatrix}$ (b) $\begin{bmatrix}1+yz & z\\ y & 1\end{bmatrix}$

(c) $\begin{bmatrix}1 & z\\ y & 1+yz\end{bmatrix}$ (d) $\begin{bmatrix}1 & 1+yz\\ z & y\end{bmatrix}$

[ESE-2006]

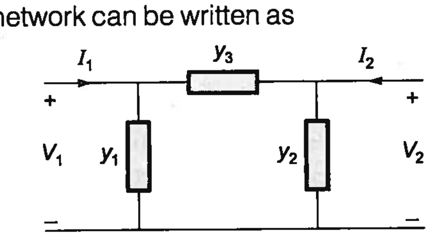
Q.26 What is the value of the parameter h_{12} for the 2-port network shown in the figure given below?



(a) 0.125 (b) 0.167
(c) 0.250 (d) 0.625

[ESE-2006]

Q.27 The currents I_1 and I_2 at the output of 2-port network can be written as



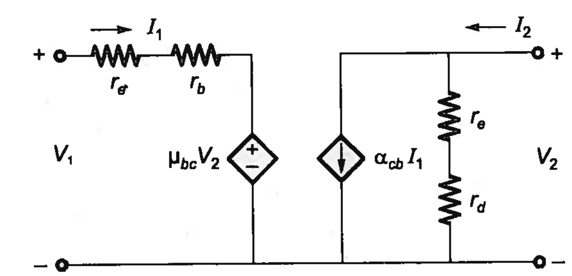
Equivalent π network

$I_1=5V_1-V_2$
$I_2=-V_1+V_2$

Which one of the following gives the parameters of an equivalent π network shown above?
(a) $y_1=4$ ℧, $y_2=0$, $y_3=1$ ℧
(b) $y_1=4$ ℧, $y_2=4$ ℧, $y_3=1$ ℧
(c) $y_1=1$ ℧, $y_2=1$ ℧, $y_3=1$ ℧
(d) $y_1=4$ ℧, $y_2=0$, $y_3=2$ ℧

[ESE-2006]

Q.28 Consider the two port transistor circuit as given below:
Match **List-I (Hybrid Parameter)** with **List-II (Circuit Element)** and select the correct answer using the code given below in the lists:



List-I	List-II
A. h_{11}	1. $\frac{1}{r_e+r_d}$
B. h_{12}	2. r_b+r_e
C. h_{21}	3. μ_{bc}
D. h_{22}	4. α_{cb}

Codes:

	A	B	C	D
(a)	2	1	4	3
(b)	4	3	2	1
(c)	2	3	4	1
(d)	4	1	2	3

[ESE-2006]

Q.29 A two-port network is represented by $ABCD$ parameters given by

$$\begin{bmatrix}V_1\\ I_1\end{bmatrix}=\begin{bmatrix}A & B\\ C & D\end{bmatrix}\begin{bmatrix}V_2\\ -I_2\end{bmatrix}$$

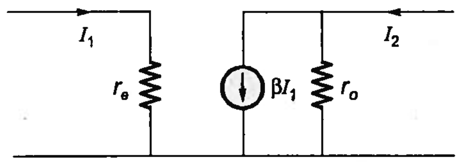
If port-2 is terminated by R_L, the input impedance seen at port-1 is given by

(a) $\frac{A+BR_L}{C+DR_L}$ (b) $\frac{AR_L+C}{BR_L+D}$

(c) $\frac{DR_L+A}{BR_L+C}$ (d) $\frac{B+AR_L}{D+CR_L}$

[GATE-2006]

Q.30 In the two port network shown in the figure below, Z_{12} and Z_{21} are, respectively



(a) r_e and βr_0 (b) 0 and $-\beta r_0$
(c) 0 and βr_0 (d) r_e and $-\beta r_0$

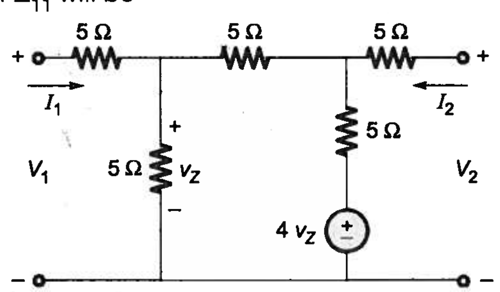
[GATE-2006]

Q.31 For determining the network functions of a two-port network, it is required to consider that

(a) all initial conditions remain same
(b) all initial conditions are zero
(c) part of initial conditions are equal to zero
(d) initial conditions vary depending on nature of network

[ESE-2009]

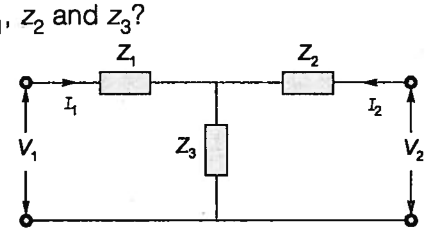
Q.32 With reference to the below network the value of Z_{11} will be



(a) –3 (b) 3
(c) –1 (d) –5

[ESE-2009]

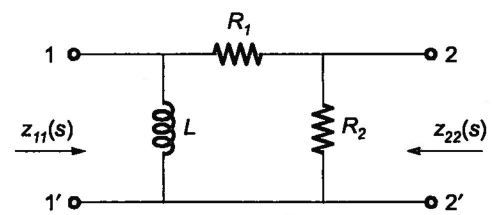
Q.33 If the Z-parameters for the T-network as shown below are z_{11} = 40 Ω, z_{22} = 50 Ω and $z_{12} = z_{21}$ = 30 Ω, then what are the values of z_1, z_2 and z_3?



(a) 10 Ω, 20 Ω and 30 Ω
(b) 20 Ω, 30 Ω and 20 Ω
(c) 30 Ω, 40 Ω and 10 Ω
(d) 40 Ω, 50 Ω and 10 Ω

[ESE-2009]

Q.34 For the circuit shown below, the natural frequencies at port 2 are given by $s + 2 = 0$ and $s + 5 = 0$, without knowing which refers to open-circuit and which to short-circuit. Then the impedances Z_{11} and Z_{22} are given respectively by



(a) $K_1\dfrac{s+5}{s+2}$, $K_2\dfrac{s+2}{s+5}$

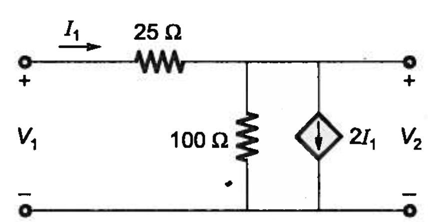
(b) $K_1\dfrac{s+2}{s+5}$, $K_2\dfrac{s+5}{s+2}$

(c) $K_1\dfrac{s}{s+5}$, $K_2\dfrac{s+2}{s+5}$

(d) $K_1\dfrac{s+2}{s+5}$, $K_2\dfrac{s+2}{s+5}$

[ESE-2010]

Q.35 The Y-parameters of the network shownbelow are

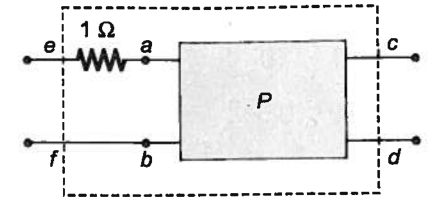


(a) $\begin{bmatrix} -0.04 & 0.04 \\ -0.04 & 0.03 \end{bmatrix}$ (b) $\begin{bmatrix} 0.04 & -0.04 \\ 0.04 & -0.03 \end{bmatrix}$

(c) $\begin{bmatrix} 0.04 & -0.03 \\ -0.04 & 0.03 \end{bmatrix}$ (d) $\begin{bmatrix} -0.04 & 0.04 \\ 0.04 & 0.03 \end{bmatrix}$

[ESE-2010]

Q.36 The two-port network P shown in the figure has port 1 and 2, denoted by terminals (a, b) and (c, d), respectively. It has an impedance matrix Z with parameters denoted by z_{ij}. A 1 Ω resistor is connected in series with the network at port 1 as shown in the figure. The impedance matrix of the modified two-port network (shown as a dashed box) is



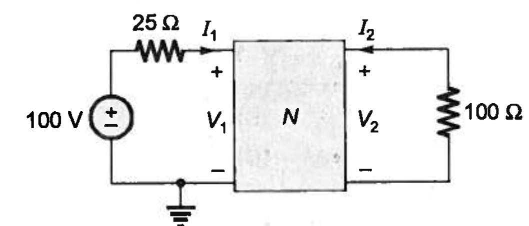
(a) $\begin{bmatrix} z_{11}+1 & z_{12}+1 \\ z_{21} & z_{22}+1 \end{bmatrix}$ (b) $\begin{bmatrix} z_{11}+1 & z_{12} \\ z_{21} & z_{22}+1 \end{bmatrix}$

(c) $\begin{bmatrix} z_{11}+1 & z_{12} \\ z_{21} & z_{22} \end{bmatrix}$ (d) $\begin{bmatrix} z_{11}+1 & z_{12} \\ z_{21}+1 & z_{22} \end{bmatrix}$

[GATE-2010]

Q.37 In the circuit shown below, the network N is described by the following y matrix:

$Y = \begin{bmatrix} 0.1S & -0.01S \\ 0.01S & 0.1S \end{bmatrix}$. The voltage gain $\dfrac{V_2}{V_1}$ is



(a) 1/90 (b) –1/90
(c) –1/99 (d) –1/11

[GATE-2011]

Q.38 A 2-port network is represented by the following equations:

$V_1 = 60\,I_1 + 20\,I_2$
$V_2 = 20\,I_1 + 40\,I_2$

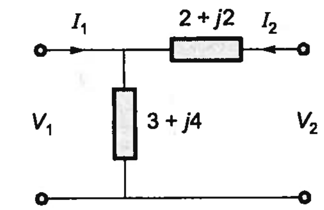
The ABCD parameters of the above network would be

(a) $\begin{bmatrix} 2 & \frac{1}{20} \\ 3 & 100 \end{bmatrix}$ (b) $\begin{bmatrix} 100 & 3 \\ 2 & \frac{1}{20} \end{bmatrix}$

(c) $\begin{bmatrix} 100 & 20 \\ 6 & 3 \end{bmatrix}$ (d) $\begin{bmatrix} 3 & 100 \\ \frac{1}{20} & 2 \end{bmatrix}$

[ESE-2013]

Q.39 The Z-parameter matrix of the two-port network as shown below is

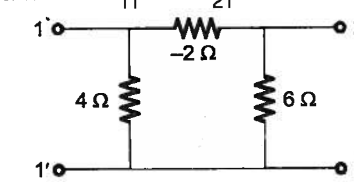


(a) $\begin{bmatrix} 3+j4 & 2+j2 \\ 2+j2 & 5+j6 \end{bmatrix}$ (b) $\begin{bmatrix} 3+j4 & 3+j4 \\ 3+j4 & 5+j6 \end{bmatrix}$

(c) $\begin{bmatrix} 2+j2 & 3+j4 \\ 2+j2 & 5+j6 \end{bmatrix}$ (d) $\begin{bmatrix} 3+j4 & 2+j2 \\ 1+j2 & 3+j4 \end{bmatrix}$

[ESE-2013]

Q.40 For the two port network as shown below, the parameters h_{11} and h_{21} are

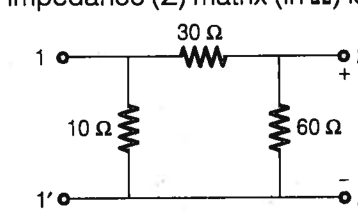


(a) 1 Ω and 2 Ω (b) 2 Ω and 1

(c) 1 and $\frac{1}{2}$ Ω (d) $\frac{1}{2}$ Ω and 1

[ESE-2013]

Q.41 For the two-port network shown in the figure, the impedance (Z) matrix (in Ω) is

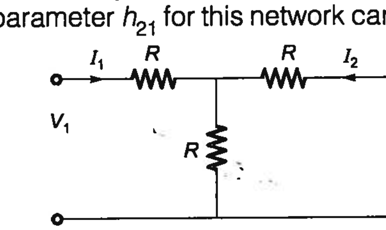


(a) $\begin{bmatrix} 6 & 24 \\ 42 & 9 \end{bmatrix}$ (b) $\begin{bmatrix} 9 & 8 \\ 8 & 24 \end{bmatrix}$

(c) $\begin{bmatrix} 9 & 6 \\ 6 & 24 \end{bmatrix}$ (d) $\begin{bmatrix} 42 & 6 \\ 6 & 60 \end{bmatrix}$

[GATE-2014]

Q.42 A 2-port network is shown in figure. The parameter h_{21} for this network can be given by

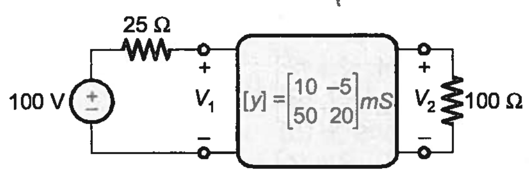


(a) –1/2 (b) +1/2
(c) –3/2 (d) +3/2

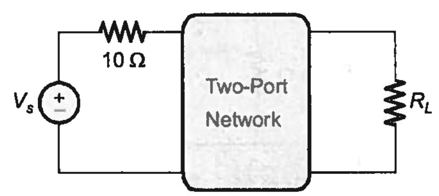
[ESE-2015]

Numerical Data Type Questions

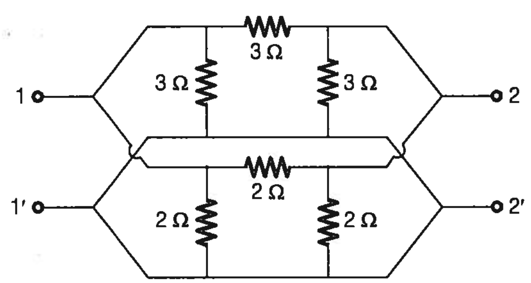
Q.43 For the circuit shown below the voltge V_1 is ___ Volts.



Q.44 The two-port network in the following circuit has z-parameters $z_{11} = 40\ \Omega$, $z_{12} = 60\ \Omega$, $z_{21} = 80\ \Omega$ and $z_{22} = 120\ \Omega$. If $V_s = 60$ V, then maximum power delivered to the load R_L will be ______ watts.

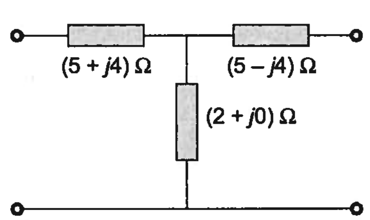


Q.45 In the h-parameter model of the 2-port network given in the figure shown, the value of h_{22} (in S) is ____.



[GATE-2014]

Q.46 The *ABCD* parameters of the following 2-port network are



(a) $\begin{bmatrix} 3.5+j2 & 20.5 \\ 20.5 & 3.5-j2 \end{bmatrix}$

(b) $\begin{bmatrix} 3.5+j2 & 0.5 \\ 0.5 & 3.5-j2 \end{bmatrix}$

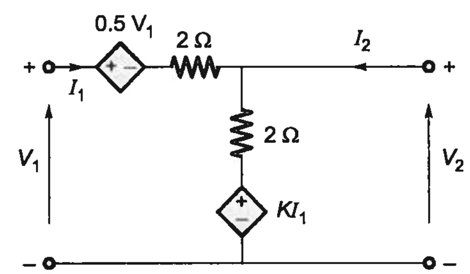
(c) $\begin{bmatrix} 10 & 2+j0 \\ 2+j0 & 10 \end{bmatrix}$

(d) $\begin{bmatrix} 7+j4 & 0.5 \\ 30.5 & 7-j4 \end{bmatrix}$

[GATE-2015]

Try Yourself

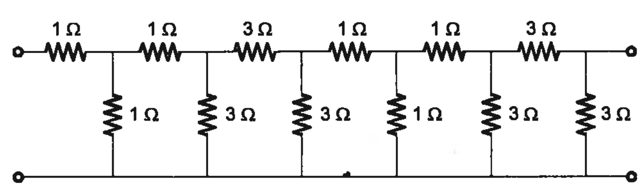
T1. When given network satisfy the reciprocity. Find the value of '*K*'



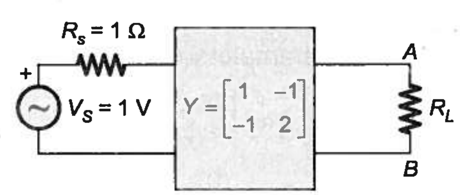
(a) 2 (b) – 2

(c) 1 (d) – 1

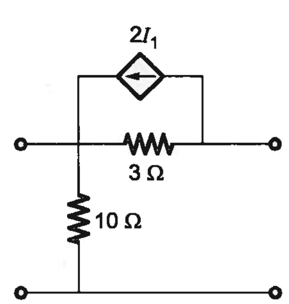
T2. Find Z_{22}



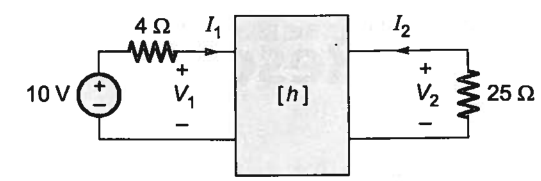
T3. Find I_{sc} with respect to *A* and *B*



T4. Find *Z*-parameters of the circuit shown



T5. Find the two-port shown



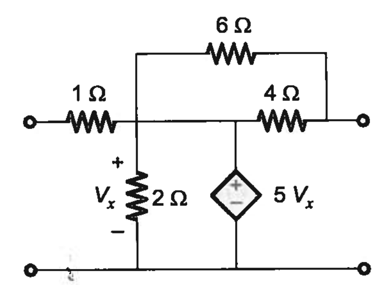
$[h] = \begin{bmatrix} 16\ \Omega & 3 \\ -2 & 0.01\text{s} \end{bmatrix}$

Find

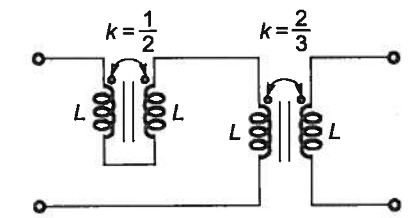
(a) $\dfrac{V_2}{V_1}$ (b) $\dfrac{I_2}{I_1}$

(c) $\dfrac{I_1}{V_1}$ (d) $\dfrac{V_2}{I_1}$

T6. Find *ABCD* parameters of the network shown



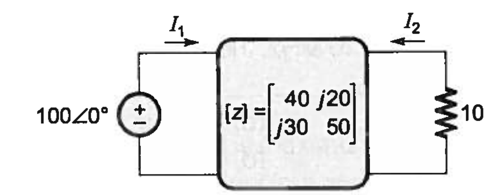
T7. In the following circuit the z-parameters for $L = 3$ H are



(a) $\begin{bmatrix} 7.5s & 2s \\ 2s & 3s \end{bmatrix}$ (b) $\begin{bmatrix} 7.5s & -2s \\ -2s & 3s \end{bmatrix}$

(c) $\begin{bmatrix} 6s & 2s \\ 2s & 3s \end{bmatrix}$ (d) $\begin{bmatrix} 2s & 3s \\ 6s & 2s \end{bmatrix}$

T8. In the given two port network what are the values of current I_1 and I_2?



(a) 2∠0° A, 1∠90° A

(b) 2∠0° A, 1∠0° A

(c) 2∠0° A, 1∠–90° A

(d) 2∠–90° A, 1∠–90° A