BE(ECE) III - Semester Main Exam

Sub: Network Theory.

Question paper key - Set-1

1 a) Transmission parameters: ABCD parameters are also known as transmission parameters. Here voltage and current at port ① can be expressed in terms of voltage & current at port ②

i.e $V_1 = A V_2 - B I_2$ ——①

$I_1 = C V_2 - D I_2$ ——②

where A, B, C & D are transmission parameters.

If o/p port is open circuited, $I_2 = 0$. then from eqn ① & ② we get

$A = \frac{V_1}{V_2}$ = ratio of i/p voltage to o/p voltage when o/p port is open circuited.

Also $C = \frac{I_1}{V_2}$ = ratio of i/p current to o/p voltage when o/p port is open circuited.

If o/p port is short circuited, $V_2 = 0$, then from eqn ① & ② we get

$-B = \frac{V_1}{I_2}$ = ratio of i/p voltage to o/p current

& $-D = \frac{I_1}{I_2}$ = ratio of i/p current to o/p current.

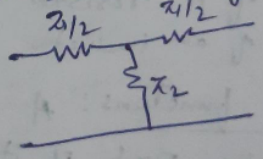
b) The condition for symmetry of a 2-port n/w in Z, Y, h & transmission parameters is given below.

$\boxed{Z_{11} = Z_{22}}$, $\boxed{Y_{11} = Y_{22}}$ $\boxed{\Delta h = 1}$ $\boxed{A = D}$

c) Symmetrical n/w: If electrical characteristics of a n/w remains unchanged if its ports are interchanged, Then the n/w is said to be symmetrical n/w.

Also, a symmetrical n/w has same impedance at both ports

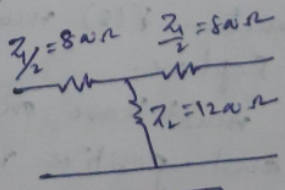
Ex: i) a symmetrical T-n/w.



ii) a 1:1 transformer.

d) Given $\frac{Z_1}{2} = 8\omega\Omega$ & $Z_2 = 12\omega\Omega$

$\Rightarrow Z_1 = 16\omega\Omega$



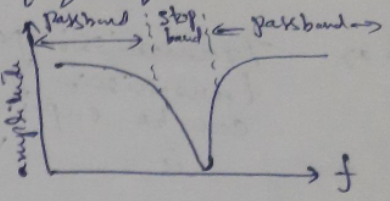
Characteristic impedance

$Z_{0T} = \sqrt{\frac{Z_1^2}{4} + Z_1 Z_2} = \sqrt{\frac{(16\omega)^2}{4} + 16\omega \times 12\omega} = \underline{1600\,\Omega}$

e) Constant K-filter: A constant K filter is a T or Π n/w in which the series and shunt impedances Z_1 and Z_2 are so designed that they have the relation $Z_1 Z_2 = R_K^2$ where R_K is a real constant, independent of frequency. It is termed as design impedance or nominal impedance of constant K-filter.

f) **Notch filter:** Basically a notch filter is a band elimination filter with a narrow stop band. It passes all frequencies except those in a stop band centered on a center frequency.

The amplitude response of a notch filter is flat at all frequencies except for the stop band on either side of the center frequency.



g) Attenuation in decibil is

$$\alpha_{dB} = 20 \log_{10} \frac{V_i}{V_0} \quad \text{---(1)}$$

Neper is defined as the natural logarithm of voltage at input port to voltage at o/p port.

$$\alpha_N = \log_e \frac{V_i}{V_0} \quad \text{---(2)}$$

Consider

$$\alpha_{dB} = 20 \log_{10} \frac{V_i}{V_0}$$

using change of base theorem

$$\alpha_{dB} = 20 \frac{\log_e V_i/V_0}{\log_e 10} = 20 \frac{\alpha_N}{2.302}$$

$$\boxed{\alpha_{dB} = 8.686\, \alpha_N.}$$

or $\alpha_N = 0.115\, \alpha_{dB}$.

h) Two impedances Z_1 & Z_2 are said to be inverse when their geometric mean is a real number

i.e $Z_1 Z_2 = R^2$ where R is a resistance.

Ex. Inverse of a resistor is another resister.
Inverse of an inductor is capacitor & vice-versa.

i) **Positive real functions:** A rational function $F(s)$ with real coefficients are said to be prf if it satisfies the following conditions.

i) n/w function $F(s)$ must have no poles in the right half of s-plane.

ii) $F(s)$ must have only simple poles on the $j\omega$ axis with real and positive residues.

j) Network analysis is a process through which we calculate various electrical parameter of a circuit elements connected in an electrical n/w.

Network Synthesis is a design technique for linear electrical circuits. Synthesis starts from a prescribed impedance function of frequency and then determines the possible networks that will produce the required response.