B. Tech.

(SEM. III) EXAMINATION, 2008-09
NETWORK ANALYSIS & SYNTHESIS

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions. All questions carry equal marks. In case of numerical problems assume data wherever not provided.

1 Attempt any four parts of the following : 5×4=20

(a) Explain the duality principle with suitable example in graph theory.

(b) Obtain the fundamental loop and fundamental cutset matrices for the graph given in Fig. 1 (b).

Fig. 1 (b)
(c) Determine the number of branches, number of nodes and number of links. Also develop network equilibrium equation of the network given in Fig. 1 (c).

![Image of network diagram](image1)

**Fig. 1 (c)**

(d) Derive the relation between branch current matrix and loop current matrix.

(e) Differentiate between subgraph and connected graph. Enlist the properties of incidence matrix in a graph.

(f) A resistive network is shown in **Fig. 1 (f)**. Setup corresponding tie-set matrix and obtain kVL equation.

![Image of network diagram](image2)

**Fig. 1 (f)**
Attempt any **three** parts of the following: $\frac{2}{3} \times 3 = 20$

(a) Find the current in $2 \, \Omega$ resistance in the network shown in Fig. 2 (a) using Norton's theorem.

![Fig. 2 (a)](image)

(b) Using Millman's theorem, find the current through $(4 + j3) \, \Omega$ in the network shown in Fig. 2 (b).

![Fig. 2 (b)](image)
(c) In the network of Fig. 2 (c) find the maximum power in \((6 + j8)\ \Omega\).

\[ \begin{array}{c}
\begin{array}{c}
20\ \Omega \\
100 \angle 0^\circ V
\end{array}
\end{array} \quad \begin{array}{c}
\begin{array}{c}
j10 \Omega
\end{array}
\end{array} \quad \begin{array}{c}
\begin{array}{c}
6 + j8 \Omega
\end{array}
\end{array} \]

Fig. 2 (c)

(d) Determine the current in the capacitor branch by superposition theorem in the current of Fig. 2 (d).

\[ \begin{array}{c}
\begin{array}{c}
3 \Omega \\
3 \Omega
\end{array}
\end{array} \quad \begin{array}{c}
\begin{array}{c}
-j4 \Omega
\end{array}
\end{array} \quad \begin{array}{c}
\begin{array}{c}
4 \angle 0^\circ V
\end{array}
\end{array} \quad \begin{array}{c}
\begin{array}{c}
\sin
\end{array}
\end{array} \quad \begin{array}{c}
\begin{array}{c}
\cos
\end{array}
\end{array} \]

Fig. 2 (d)

(e) State and explain compensation theorem in ac network.

3 Attempt any two parts of the following: \(10 \times 2 = 20\)

(a) Check the stability criteria of the following polynomial by applying Routh-Hurwitz criterion:

\[ P(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 \]

(i) \[ P(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 \]

(ii) The characteristic equation of a feedback control system is

\[ s^4 + 20ks^3 + 4s^2 + 10s + 15 = 0 \]

Find the range of \(k\) for the system to be stable.

[Contd...]
(b) Draw the pole-zero diagram of given network function and hence time domain response \( i(t) \).

\[
I(s) = \frac{s^2 + 4s + 5}{s^2 + 2s}
\]

(c) Enlist the properties of transfer function of a network. Obtain the driving point immittance of the network shown in Fig. 3 (c).

![Fig. 3 (c)](image)

4 Attempt any two parts of the following : 10×2=20

(a) Obtain the z-parameters of the network shown in Fig. 4 (a).

![Fig. 4 (a)](image)
(b) Determine $Y$-parameters of two-part network shown in Fig. 4 (b).

(c) Determine lattice equivalent of the network shown in Fig. 4 (c).

5 Answer any two parts of the following: 10×2=20

(a) Develop the Foster-II and Cauer-I network for the given function:

$$z(s) = \frac{s^5 + 5s^3 + 3s}{s^4 + 3s^2 + 1}$$
(b) Enlist the properties of positive real function. Also determine whether the given polynomials are hurwitz or not:

(i) \( s^4 + 7s^3 + 4s^2 + 18s + 6 \)

(ii) \( s^5 + s^3 + 5 \)

(c) Enlist the properties of a filter. Design an m-derived low pass filter having design resistance \( R_0 = 500 \, \Omega \), cut-off frequency \( f_c = 1500 \, Hz \) and infinite attenuation frequency \( f_\infty = 2000 \, Hz \).