3rd Semester B.Tech Examination, Nov. 2004

NETWORK THEORY

Full Marks : 70

Time : 3 hours

Q. No. 1 is compulsory. Attempt any **five** questions from the rest

The figures in the right-hand margin indicate marks

1. Answer the following:

   (*i*) Find the initial and final value of the function $f(t)$ whose Laplace transform is given by

$$F(s) = \frac{(s+4)}{(s+1)(s+3)}$$

   (*ii*) For the *T*-network shown in *Fig.* Q. 1 (*ii*), the impedances z_{11}, z_{12} and z_{22} will be given by ——.

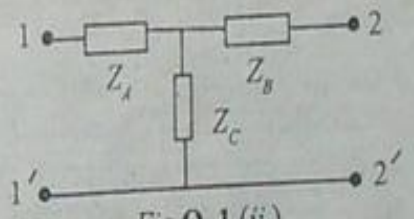

Fig Q. 1 (*ii*)

(*Turn Over*)

(*iii*) In the *Fig.* Q. 1 (*ii*) above, if $Z_A = Z_B$, then the iterative impedance will be given by ——.

(*iv*) Give a Mathematical Statement of 'Reciprocity Theorem'.

(*v*) For a two-port network the image impedances are Z_{i1} and Z_{i2}; then if the terminals 2 - 2′ are terminated by ——, the impedance measured from 1 - 1′ is ——.

(*vi*) For a Chebyshev low-pass filter, the ripple width decides the value of —— in the gain function, which can be written as ——.

(*vii*) Why are not the following functions positive real ?

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

(*b*) $\dfrac{s^3+7s^2+15s+9}{s^4+6s^2+9}$

(*viii*) For a low-pass L-C filter, if the value of L is doubled, the characteristic impedance and the cut-off frequency will be changed to —— and —— times the original values respectively.

(*Continued*)

(*ix*) For a circuit with $R = 4$ ohm, $L = 25$ mH and $C = 150$ μF in series, the bandwidth will be ——.

(*x*) Given the dot convention for the figure, indicate the positive direction of current I_2 when I_1 is positive and 2-2 are shorted. 2×10

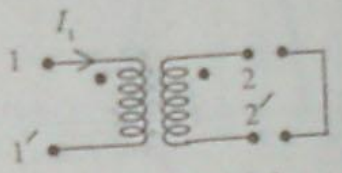

Fig Q. 1 (*x*)

2. (*a*) Determine the current through the 5V battery and the power supplied by all the sources in the circuit in *Fig.* Q. 2 (*a*). 5

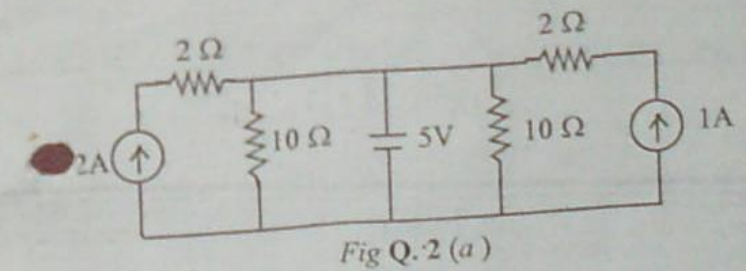

Fig Q. 2 (*a*)

(*Turn Over*)

(*b*) For the network in *Fig.* **Q. 2** (*b*), determine the maximum power received at the load R_L. 5

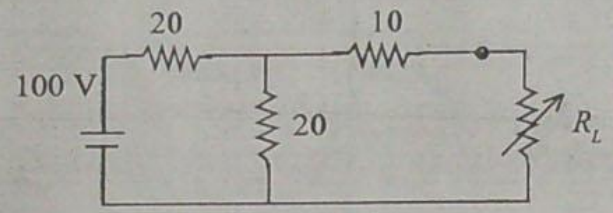

Fig **Q. 2** (*b*)

3. (*a*) Determine the *ABCD* parameters of the network shown in *Fig.* **Q. 3** (*a*). 5

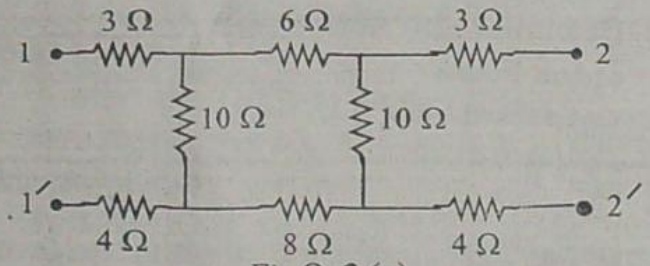

Fig **Q. 3** (*a*)

(*b*) Calculate the *y*-parameters for the network in *Fig.* **Q. 3** (*b*). 5

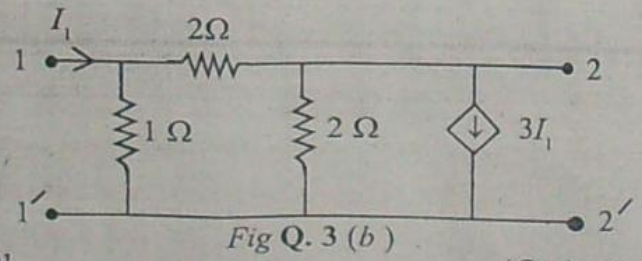

Fig **Q. 3** (*b*)

(*Continued*)

4. (*a*) Determine the Laplace transform of

(*i*) $t^2 e^{-3t} \cos 5t$

(*ii*) the waveform shown in *Fig.* **Q. 4** (*a*). 5

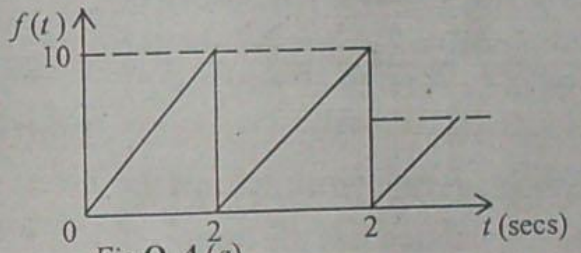

Fig **Q. 4** (*a*)

(*b*) Determine the inverse Laplace transform of

$$F(s) = \frac{n!}{s\,(s+1)\,(s+2)\ldots(s+n)}.$$ 5

5. (*a*) The switch S is initially in position 0 (*Fig.* **Q. 5** (*a*). It is thrown to position '1' at $t = 0$. After a steady state is reached, it is put quickly on position 2 at $t = t_1$. Write the expression for the current $i_L(t)$ for $0 \leq t \leq t_1$ and $t_1 \leq t \leq \alpha$. 5

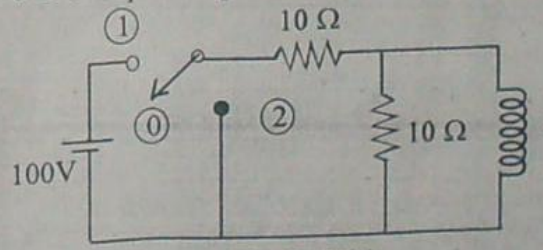

Fig **Q. 5** (*a*)

(*Turn Over*)

(*b*) Show the current waveform in both the cases. 3

(*c*) If the switch is opened at $t = t_1$ instead of closing on to position 2, what will be the voltage across the switch S at $t = t_1 (+)$. 2

6. (*a*) For the network shown in *Fig.* Q. 6 (*a*). Show that the impedance has the form

$$Z(s) = \frac{K(s - z_1)}{(s - p_1)(s - p_2)}$$

and determine the values of z_1, p_1 and p_2 in terms of R, L and C. 5

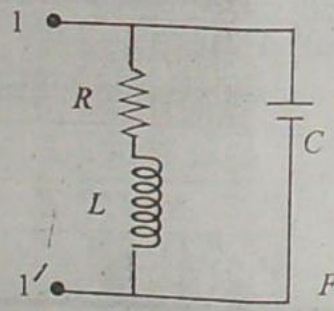

Fig Q. 6 (*a*)

(*b*) If the poles and zeros are located as shown in *Fig.* Q. 6 (*b*) and $Z(j0) = 1$, find the values of R, L and C. 5

(*Continued*)

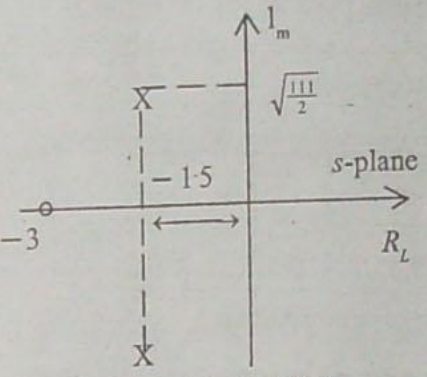

Fig Q. 6 (*b*)

7. (*a*) Determine the coefficients a_n's and b_n's of the Fourier series for the rectified sine wave shown in *Fig* Q. 7 (*a*). 5

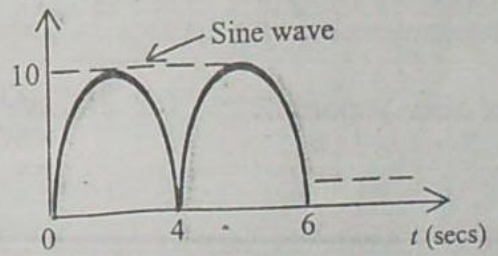

Fig Q. 7 (*a*)

(*Turn Over*)

(*b*) Determine the Fourier transform of the cosine pulse shown in *Fig.* **Q. 7** (*b*).

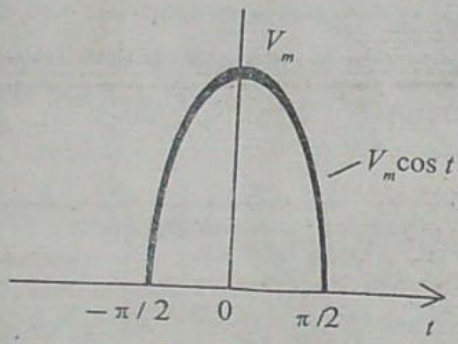

Fig **Q. 7** (*b*)

8. Synthesize each of the following network function in any two canonical forms: 5+5

(*a*) $Z(s) = 5\,\dfrac{s+6}{(s+3)\,(s+9)}$

(*b*) $Y(s) = 10\,\dfrac{s\,(s^2+9)}{(s^2+1)\,(s^2+16)}$.

$t^n = \dfrac{(n+1)!}{s^{n+1}}$

KB—3,000