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Name ....

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THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JANUARY 2003

EC2K. 302. ELECTRICAL CIRCUITS AND NETWORK THEORY

(New Scheme)

Time : Three Hours — Maximum : 100 Marks

Answer **all** *questions.*

1. (a) Name the various types of sources and explain.

(b) State and explain maximum power transfer theorem.

(c) State and prove initial value theorem.

(d) Find the inverse Laplace transform of the function $F(s) = \frac{1}{(s-a)^2}$, using convolution theorem.

(e) Express *y*-parameters in terms of *z*-parameters.

(f) The network N of the figure 1 is terminated at port 2 in impedance $Z_L = \frac{1}{y_L}$. Show that the transfer impedance for the combination is $Z_{12} = \frac{z_{21}Z_L}{z_{22}+Z_L}$.

FIG. 1.

(g) Explain the properties of positive Real functions.

(h) State and explain Sturm's theorem.

(8 × 5 = 40 marks)

2. (a) (i) In the network of the figure, a steady state is reached with switch K open. At $t = 0$, switch K is closed. Find $i(t)$, sketch the current waveform and indicate the value of the time constant.

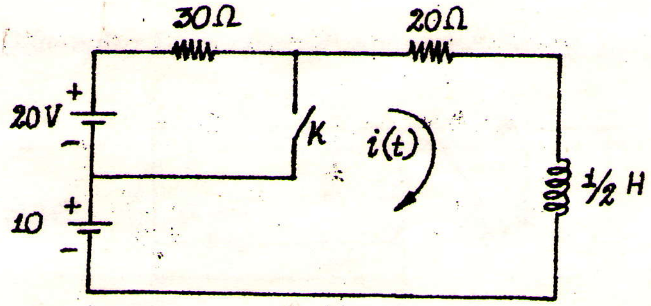

FIG. 2.

(8 marks)

Turn over

(ii) For the network shown in figure, prove that $V_\theta = \frac{V_1}{2}(1 + a + b - ab)$ and $Z_\theta = \frac{3-b}{2}$.

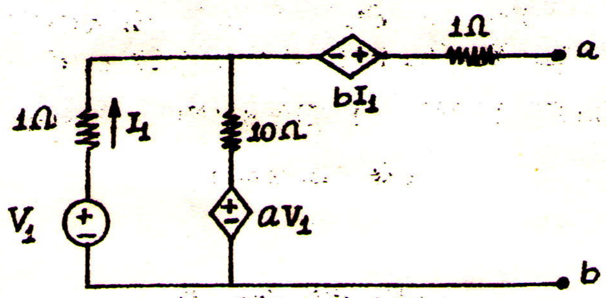

FIG.3.

(7 marks)

Or

(b) (i) Determine the Norton equivalent network for the terminals acts in the figure for zero initial condition.

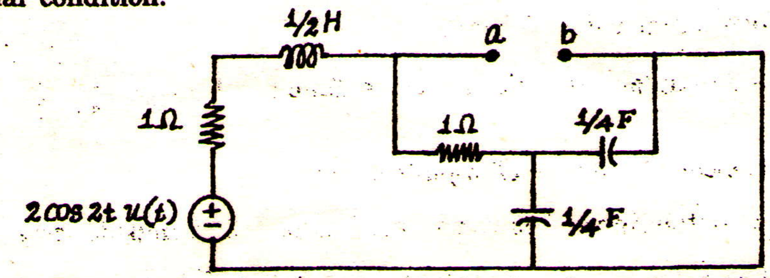

FIG.4.

(7 marks)

(ii) In the given network, the 10 μF capacitor is charged to 1000 V and switch K is closed at $t = 0$. Solve for $\frac{d^2 i_2}{dt^2}$ at $t = 0^+$.

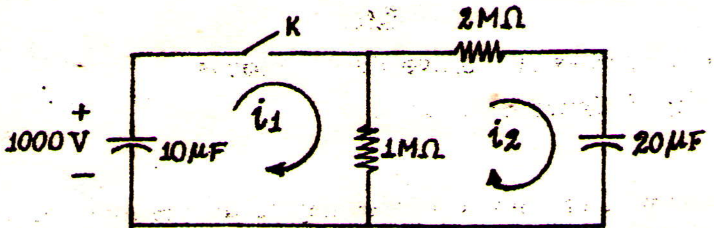

FIG.5.

(8 marks)

3. (a) (i) In the network of the figure, determine the numerical value of i_1.

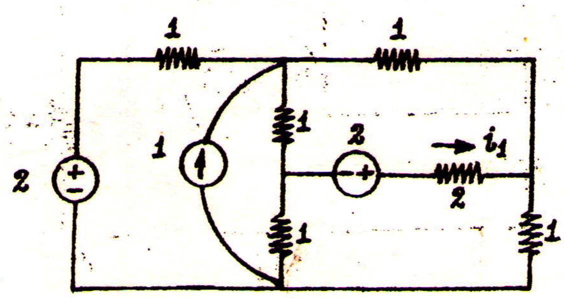

FIG.6.

(7 marks)

(ii) In the network shown, the switch K is closed at $t = 0$. Show that current $i(t)$ is given by the equation

$$i(t) = \frac{V}{Z}\sin(wt - \phi) + \frac{WLV}{Z^2}e^{-Rt/L}$$

where $Z = \sqrt{R^2 + (WL)^2}$ and $\phi = \tan^{-1}\frac{WL}{R}$.

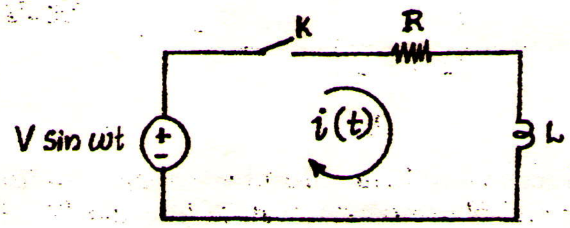

FIG. 7.

(8 marks)

Or

(b) (i) What must be the relationship between L_{eq} and L_1, L_2 and M for networks to be equivalent ?

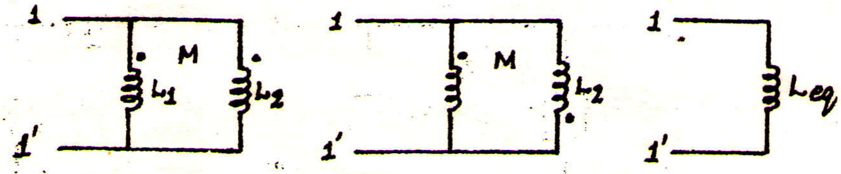

FIG. 8.

(7 marks)

(ii) Show that with $Z_a Z_b = R_o^2$ in the Bridged T-network of the figure.

$$\frac{V_2}{V_1} = \frac{1}{1 + Za / R_o}$$

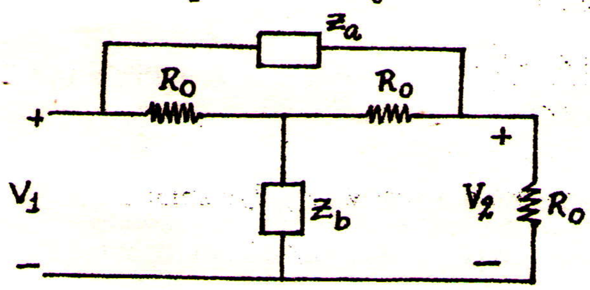

FIG. 9.

(8 marks)

4. (a) (i) Find y and z parameters for the network shown in figure.

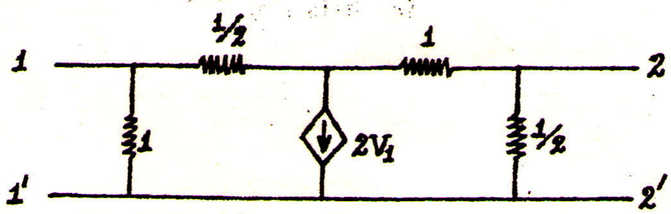

FIG. 10.

(8 marks)

Turn over

(ii) The network N in the Fig. may be described by the z parameters. Show that with port 2 open, $G_{12} = \frac{z_{21}}{z_{11}}$.

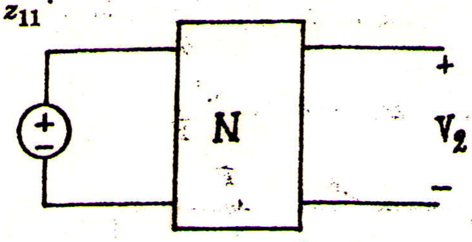

FIG. 11.

(7 marks)

Or

(b) (i) Design a constant K, T section high pass filter having $f_C = 10$ kHz and $R_0 = 600\ \Omega$. Also find (1) its Z_{OT} and phase constant at 25 kHz and (2) attenuation at 5 kHz.

(8 marks)

(ii) For the two networks shown in Fig., show that the two networks are equivalent if $Y_a = Z_2/D$, $Y_b = Z_2/D$ and $Y_C = Z_1/D$, where $D = Z_1Z_2 + Z_2Z_3 + Z_3Z_1$.

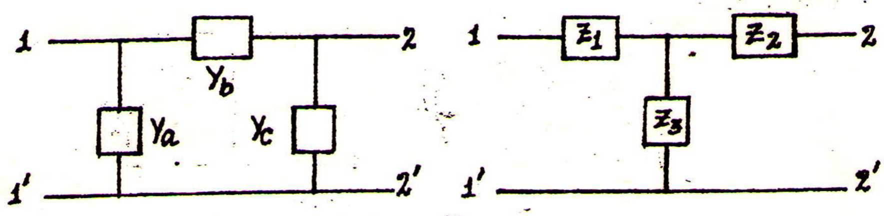

FIG. 12.

(7 marks)

5. (a) (i) Test each of the functions for positive real function :

(1) $\frac{s^3 + 6s^2 + 7s + 3}{s^2 + 2s + 1}$.

(2) $\frac{2s^3 + s^2 + 4s + 1}{s^3 + 3s^2 + 3s + 1}$.

(8 marks)

(ii) Explain the properties of Hurwitz polynomials. (7 marks)

Or

(b) Obtain all the Foster and Cauer realizations of the driving point function

$$Z(s) = \frac{(s+1)(s+4)}{(s+3)(s+5)}.$$

(15 marks)

[4 × 15 = 60 marks]