

### CIRCUIT & FIELD THEORY

*Time: Three Hours*

*Maximum Marks: 100*

*Answer five questions, taking ANY TWO from Group A, any two from Group B and all from Group C.*

*All parts of a question (a, b, etc. ) should be answered at one place.*

*Answer should be brief and to-the-point and be supplemented with neat sketches.*

*Unnecessary long answer may result in loss of marks.*

*Any missing or wrong data may be assumed suitably giving proper justification.*

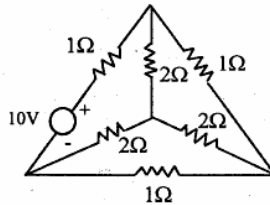
*Figures on the right-hand side margin indicate full marks.*

#### Group A

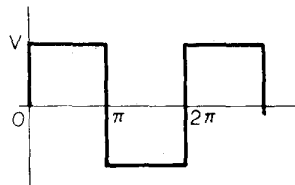
1. (a) What is incidence matrix? Write the properties of incidence matrix. Draw the graph corresponding to the incidence matrix given below : 6

$$[A_i] = \begin{bmatrix} 1 & 0 & 0 & 1 \\ -1 & 1 & 1 & 0 \\ 0 & -1 & -1 & -1 \end{bmatrix}$$

- (b) What do you mean by twig matrix and link matrix ? With reference to Fig., draw the graph and write the tie-set matrix. 6



- (c) A square waveform is shown in figure. Obtain the Fourier series. 8

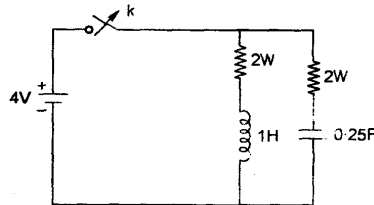


2. (a) Write short notes on Initial and Final value theorems. 6

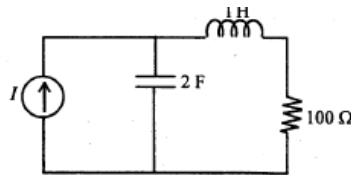
- (b) Find the inverse Laplace transform of the following 6

(i)  $F(s) = \frac{s+1}{s^3 + s^2 - 6s}$       (ii)  $F(s) = \frac{s+2}{s^5 - 2s^4 + s^3}$

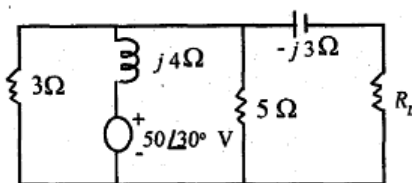
- (c) In the given network, switch K is opened at time  $t = 0$ , the steady state having established previously. With switch K open, draw the transform network representing all elements and all initial conditions. Write the transform equation for current in the loop. Also find the current  $i(t)$  in the loop. 8



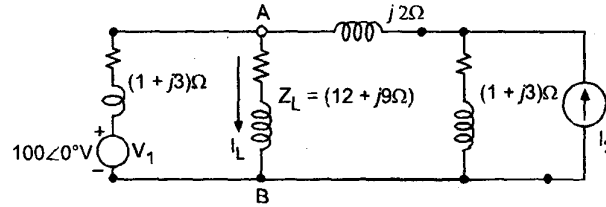
3. (a) Find the pole zero locations of the current transfer ratio ( $I_2/I_1$ ) in  $s$  domain for the circuit shown in figure. 8



- (b) What should be the value of  $R_L$  so that the maximum power can be transferred from the source to  $R_L$  as shown in Fig. Also, calculate the maximum power which can be transferred to  $R_L$ . 6



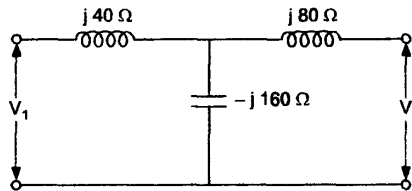
- (c) Determine the load current  $I_L$ , for the network shown in following figure using Thevenin's theorem. Given:  $V_1 = 100\angle 0^\circ$  and  $I_2 = 35\angle -50^\circ$  A (upward). 6



4. (a) A series RLC circuit consists of  $50 \Omega$  resistance,  $0.2 \text{ H}$  inductance and  $10 \mu\text{F}$  capacitance with applied voltage of  $20 \text{ V}$ . Determine resonance frequency. Find Q factor of the circuit. Compute the lower and upper frequency limits and the bandwidth of the circuit. 6
- (b) Show that the resonant frequency  $f_0$  of a RLC circuit is related to the half power frequencies  $f_1$  and  $f_2$  by 6

$$f_0 = \sqrt{(f_1 / f_2)}$$

- (c) Find the z-parameters of the two port network shown below. 8



**Group B**

5. (a) State Stokes's theorem and prove that it relates a line integral to surface integral over any surface of which the line integral path is boundary (or State and prove Stoke's theorem). 10
- (b) Find the nature of following fields by determining divergence and curl: 10
- (i)  $F_1 = 301_x + 2xy1_y + 5xz^21_z$
- (ii)  $F_2 = (150 / r^2)1_r + 101_\phi$
6. (a) State and explain Gauss's law in differential form. 10
- (b) Using Gauss's theorem in electrostatics, develop Poisson's equations. How can you find Laplace equation from this? 10

7. (a) State and prove Poynting theorem. Explain the terms instantaneous, average and complex Poynting vectors. 10
- (b) State and explain Biot Savart law and derive it in integral form. 10
8. (a) State and explain Ampere's law, both in integral and differential form as used in magnetic field. 10
- (b) Write and discuss Maxwell's equations in point (differential) and integral forms. 10

***Group C***

9. Answer the following in brief: 20
- (i) Give the limitations of Gauss's law.
  - (ii) What is the limitation of superposition theorem ?
  - (iii) What is a gate function and what is its Laplace transform ?
  - (iv) Define final value theorem.
  - (v) State Millman's theorem.
  - (vi) Define curl of a vector.
  - (vii) Define magnetic dipole moment.
  - (viii) What are the causes of eddy current ?
  - (ix) Define equipotential surface.
  - (x) What is a wave ?

*(Refer our course material for answers)*

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