Con. 6787-13. **LJ-11350**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** out of the remaining **six** questions.
(3) Assume **suitable data** wherever **required** and **justify** the **same**.

1. (a) A typical PCB substrate consists of Al_2O_3 with a relative dielectric constant of 10 and a loss tangent of 0·0004 at 10 GHz. Find the conductivity of substrate. **5**
   (b) Draw the lumped element circuit model for a transmission line. Derive the expression for voltage and current travelling waves. **5**
   (c) Explain current flow in Pn junction and give the expression for I_{diff} in terms of diffusion constant and Vdiff in terms of doping concentration. **5**
   (d) A lossless 50Ω microstrip line is terminated into a load with admittance of 0·05 mS. What additional impedance has to be placed in parallel with load to assure impedance of 50 Ω. **5**

2. (a) A short circuited 50 Ω transmission line section operated at 1 GHz and posseses a phase velocity of 75% of the speed of light. Use both the anlytical and the Smith chart approach to determine the shortest length required to obtian : **10**
      (i) 5·6 pF Capacitor
      (ii) 4·7 nH inductor.
   (b) Explain various terminations used in Microstrip transmission line. **10**

3. (a) Starting with the equation for normalized admittance :— **10**

$$y = g + jb = \frac{1 - \Gamma}{1 + \Gamma}$$

Prove that the circle equations for the Y-Smith chart are given b y the following two formulas :—

(i) For the constant conductance circle as $\left(\Gamma r + \frac{g}{g+1}\right)^2 + \Gamma i^2 \left(\frac{1}{1+g}\right)^2$

(ii) For the constant susceptane circle as $(\Gamma r + 1)^2 + \left(\Gamma i + \frac{1}{b}\right)^2 = \left(\frac{1}{b}\right)^2$

   (b) Explain with the equivalent circuits the radio frequency behaviour of resistor, inductor and capacitor. **10**

4. (a) State and prove Kuroda's four identities. **10**
   (b) Expalin in brief the principle of operation of HEMT and RF FET along with their construction. **10**

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5. (a) Design a prototype low pass butterworth filter that will provide atleast 20dB attenuation at the frequency of f = 2f 3dB. (Calculate order) **10**

   (b) What is Miller effect ? Show that :— **10**

$$C_{M1} = C_{cb}\left(1 - \frac{V_{ce}}{V_{be}}\right) \text{ on the i/p port.}$$

$$C_{M2} = C_{cb}\left(1 - \frac{V_{be}}{V_{ce}}\right) \text{ on the o/p port.}$$

6. (a) Derive expresion for internal, external and loaded quality factors for standard series and parallel resonant circuit. **10**

   (b) Explain the function of BJT in detail. **10**

7. Write short notes on :—
   - (a) Butterworth filter **5**
   - (b) Chip components **5**
   - (c) Schottky contacts **5**
   - (d) Richard's transformaiton **5**