T.E. ETRCS & telecommunication Sem V Rev

R.F. circuit Design.

Con. 3465-10. **AN-4279**

(REVISED COURSE)

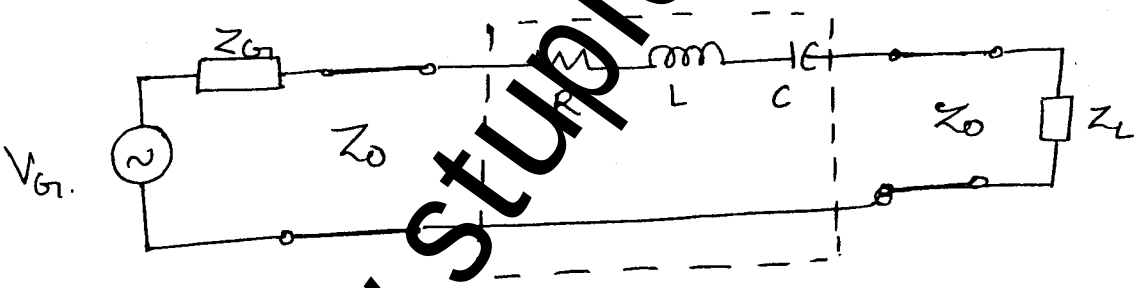
(3 Hours) **[Total Marks : 100**

N.B. (1) Question No. **1** is **compulsory**.
(2) Answer any **four** out of remaining **six** questions.
(3) Assume any **suitable** data wherever **required** but justify the **same**.
(4) **Figures** to the **right** indicate marks.

1. (a) The leads of a resistor in an RF circuit are treated as straight aluminium wires (σ Al = $4{\cdot}0 \times 10^7$ s/m) of AWG size 14 cd = 64 mil) and of total length of 5 cm. **6**
   (i) Compute the DC resistance
   (ii) Find the AC resistance and inductance at 100 MHz, 1 GHz, and 10 GHz operating frequencies.

   (b) A load impedance of 40 + j 70 ohms terminates a 100 ohms transmission line i.e. 0·3 λ long. Find the reflection coefficient of the load, the reflection coefficient at the input to the line, the input impedance, the SWR in the line and the return loss. **6**

   (c) For the filter configuration shown in the **figure** below, the following parameters are given : **4**
   Z_0 = 50 ohms, $Z_G = Z_L = Z_0$, R = 10 ohm, L = 50 nH, C = 0·47 pF, and the generator voltage is V_G = 5 V. Find the External, Internal and loaded quality factor.



   (d) Explain the design procedure of small signal BJT amplifier. (DC circuit design and RF circuit design). **4**

2. (a) A particular RF circuit requires that a line impedance of 50 ohms is to be maintained. A selected PCB board with dielectric constant of 4·6 and thickness of 40 mil. Find phase velocity and wavelength at 2 GHz. **10**

   (b) Consider the case of matching a 73 Ω load to a 50 ohm line by means of a $\lambda/4$ transformer. Assume the matching is achieved for a center frequency of f_C = 2 GHz. Plot the SWR for the frequency range $1/3 \leq f/f_C \leq 3$. **10**

3. (a) Design a prototype low-pass Butterworth filter that will provide atleast 20 dB attenuation at the frequency of f = 2 f_{3dB}. Compute and plot the amplitude response for 0 to 5 GHz. **10**

   (b) Plot the insertion loss of a low pass Chebyshev filter that has 6 dB ripple in the passband and at least 50 dB attenuation at f = 2 f cut-off. **10**

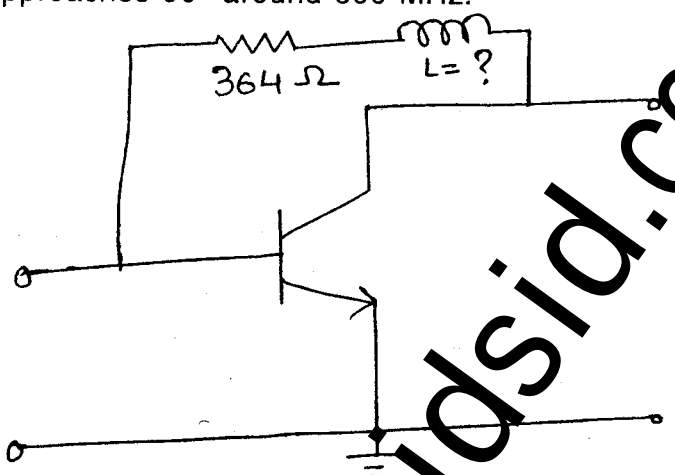
4. (a) A two-port transistorized Network have the following scattering matrix : **10**

$$[s] = \begin{bmatrix} 0{\cdot}15 \angle 0° & 0{\cdot}85 \angle -45° \\ 0{\cdot}85 \angle 45° & 0{\cdot}2 \angle 0° \end{bmatrix}$$

Determine whether the transistorized Network is Reciprocal and lossless. If port 2 is terminated with a matched load, what is the return loss seen at port 1 ? If port 2 is terminated with a short circuit, what is the return loss seen at port 1 ?.

(b) A BJT is encapsulated in a plastic housing and mounted on a heat sink (R_{thha} = 3·75 °C/w) under these conditions the total power dissipation is supposed to be 20 w. at an ambient temperature of 20 °C. What rating has the engineer to choose for the BJT casing if the maximum junction temperature should not exceed 175 °C. **10**

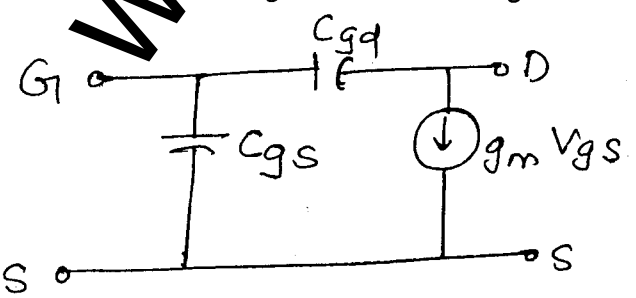
5. (a) For small signal BJT amplifier shown, find the value of inductor that would provide negative feedback above f = 600 MHz. Assume that the phase of S_{21} approaches 90° around 600 MHz. **8**



(b) An abrupt pn-junction made of Si has the acceptor and donor concentrations of $N_A = 10^{18}$ cm $^{-3}$ and $N_D = 5 \times 10^{15}$ cm^{-3}, respectively. Assuming that the device operates at room temperature, determine : **12**

(i) The barrier voltage
(ii) The space charge width in the p and n type semiconductors.
(iii) The peak electric field across the junction.
(iv) The junction capacitance for a cross sectional area of 10^{-4} cm^2 and a relative dielectric constant of $\epsilon_r = 11{\cdot}7$.

6. (a) For the simplified FET model shown determine the capacitances C_{gs} and C_{gd} as well as g_m. Show that for low frequency operation it is sufficient to record the drain current and gate-source voltage under short circuit output condition. **10**



(b) Plot and compare the frequency response of BJT, FET and HEMT. **10**

7. Write short notes on following :— **20**

(a) Chip components
(b) Matching Networks
(c) Parallel and series connections
(d) Coupled Filters.