(3 Hours) [Total Marks : 100

N.B. : (1) Question **No.1** is **compulsory**.
   (2) **Solve** any **four** questions out of remaining **six** questions.
   (3) Use of **smith chart** is **allowed**.
   (4) **Figures** to the **right** indicate **full marks**.

1. (a) What is an unilateral figure of merit of an amplifier? 5
   (b) Define signal to noise ratio and noise figure with help of a noisy network. 5
   (c) Define stability. List the various criteria for stability. 5
   (d) Explain the terms conversion loss and isolation with reference to mixer. 5

2. (a) For an ideal transformer with turns ratio $n = n_1/n_2$. Prove that the scattering matrix is : 10

$$S = \begin{bmatrix} \dfrac{n^2-1}{n^2+1} & \dfrac{2n}{n^2+1} \\[3mm] \dfrac{2n}{n^2+1} & \dfrac{1-n^2}{n^2+1} \end{bmatrix}$$

   (b) Discuss amplifier linearization methods. 10

3. A GaAs FET has the following S-parameter and noise parameters at 1.0 GHz 20
   $(Z_0 = 50\ \Omega)$ $S_{11} = 0.61 < -155^0$, $S_{12} = 0$, $S_{21} = 5.0 < 180^0$, $S_{22} = 0.51 < -20^0$,
   $F_{min} = 3dB$, $\Gamma_{opt} = 0.45 < 180^0$, $R_N = 4\Omega$. Design a Low noise amplifier for a noise
   figure of 3.5dB and power gain of 16 dB.

4. (a) Derive the transducer power gain as 10

$$G_T = \frac{P_L}{P_{avg}} = \frac{|S_{21}|^2 \left(1-|\Gamma_S|^2\right)\left(1-|\Gamma_L|^2\right)}{\left|1-\Gamma_S\Gamma_{in}\right|^2 \left|1-S_{22}\Gamma_L\right|^2}$$

   (b) Design a transistor oscillator at 4 GHz using GaAs FET in common gate configuration 10
   with 5nH inductor in series. Common gate configuration S-parameters are
   $S_{11} = 2.18 < -35^0$, $S_{21} = 2.75 < 96^0$, $S_{12} = 1.26 < 18^0$, $S_{22} = 0.52 < 155^0$, 10
   Select Γ_T so that $\Gamma_{in} > 1$.

TURN OVER

5. (a) Explain using suitable diagrams two methods of designing broadband amplifier. 10

   (b) Discuss generator tuning networks for microwave oscillators. 10

6. (a) Explain in detail single ended diode mixer. Also explain mixer design aspects. 10

   (b) A BJT with $I_C = 30$mA and $V_{CC} = 10$ V is operated at a frequency of 1.0 GHz in a 50 Ω system. 10

   $S_{11} = 0.73 < 175^0$, $S_{22} = 0.21 < -89^0$, $S_{12} = 0.0$, $S_{21} = 4.45 < 65^0$

   Is the transistor unconditionally stable? If yes, calculate the optimum terminations.

   G_{Smax}, G_{Lmax} and G_{TUmax}.

7. Write short note on : 20

   (a) Noise figure test equipment

   (b) Comparison of microwave amplifier and oscillator

   (c) 1dB compression point

   (d) Properties of scattering matrix.

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