Sem. VIII th EXTC (RON), 31/05/2014.

Adv. Microwave Engg.

QP Code : MV-19072

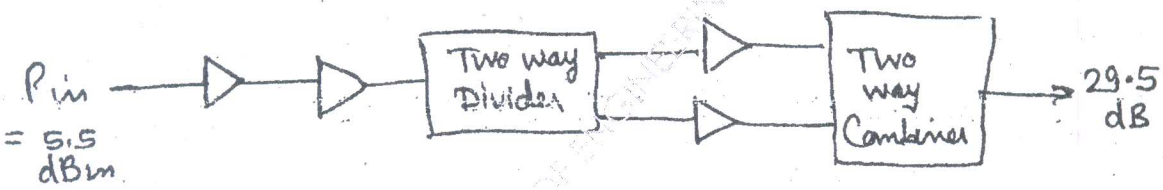
(3 Hours) **[Total Marks : 100**

N.B. (1) Question no. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** question.
(3) **Assume** suitable data wherever **necessary.**

1. (a) Define signal to noise ratio and noise figure with help of a noisy network. Explain test set up to measure signal to noise ratio. **5**
   (b) Prove that scattering matrix is symmetrical and reciprocal. **5**
   (c) Explain unilateral figure of merit. **5**
   (d) Explain the terms conversion loss and Isolation with reference to mixer. **5**

2. (a) Consider two power BJT amplifiers used in circuit configuration shown below having following specifications : **10**

Amfplifier	Go(dB)	Gi(dB)	PidB(dBm)
1	8	7	27
2	10	9	22



Assume that operating frequency is 1 GHz and input power is 5.5dBm. Specify correct BJT amplifiers that must be used at each stage to obtain 29.5 dBm output power. Assume each two way divider / combiner has 0.5 dB insertion loss.

   (b) Discuss amplifier linearization methods. **10**

3. (a) For an ideal transformer with turns ratio $n = n_1 / n_2$ prove that the scattering metrix is : **10**

$$S = \begin{bmatrix} \frac{n^2-1}{n^2+1} & \frac{2n}{n^2+1} \\ \frac{2n}{n^2+1} & \frac{1-n^2}{n^2+1} \end{bmatrix}$$

   (b) Define and explain noise correlation matrix for general noisy two port network. What is congruence transformation ? **10**

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4. Design a transistor oscillator at 6 GHz using an FET in CS configuration driving a 50 Ω load on drain side. The S-parameters at 50 Ω are **20**

$$S = \begin{bmatrix} 0.9\angle 150 & 0.2\angle -15 \\ 2.6\angle 50 & 0.5\angle 105 \end{bmatrix}$$

Calculae and plot output stability circle for $|\Gamma_{IN}| >> 1$. Choose Γ_T so that $|\Gamma_{IN}| >> 1$. Design load and terminating networks.

5. (a) Discuss various mixer topologies. Compare performance of various topologies. **10**
   (b) Discuss gerneralised single ended mixer design apporach. Give design considerations. **10**

6. (a) For a two port network the ABCD matrix is given as : **10**

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 0.5 & j1.6 \\ j1.6 & 0.5 \end{bmatrix}$$

Find scattering matrix if Zo = 50 Ω. Find condition of reciprocity.

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

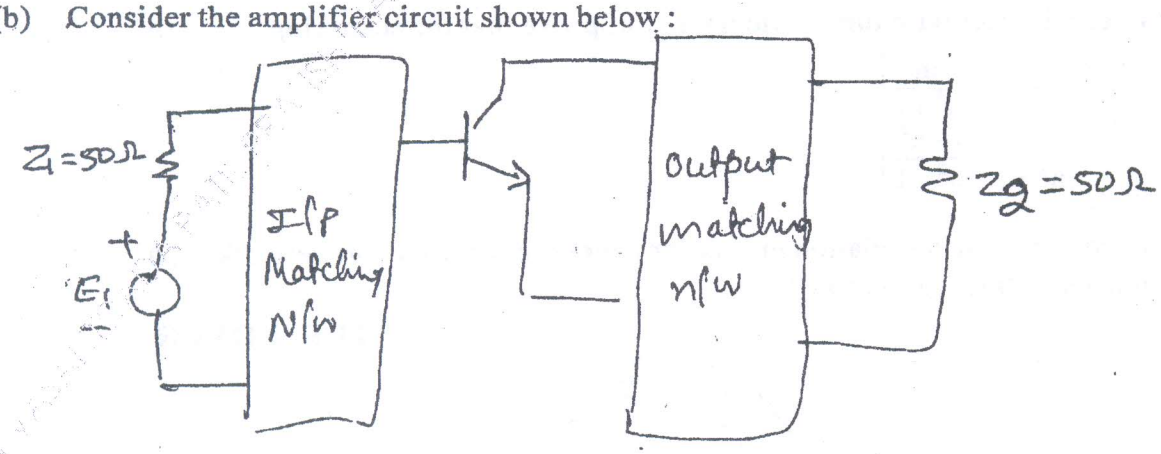
7. (a) A GaAs FET is biased for minimum noise figure and has following S parameters and noise parameters at 4 GHz (Zo =50 Ω). **15**

$$S = \begin{bmatrix} 0.6\angle -60 & 0.05\angle 26 \\ 1.9\angle 81 & 0.5\angle -60 \end{bmatrix}$$

Fmin = 1.6dB $\Gamma_{opt} = 0.62 \angle 100$ $R_N = 20\Omega$.

Design an amplifier with 2 dB noise figure and maximum gain compatible with this noise figure. Assume device is unilateral

   (b) Consider the amplifier circuit shown below : **5**



The input and output matching netwoks are to be designed using open circuited stubs for $\Gamma_S = 0.5 \angle 120$ and $\Gamma_L = 0.4 \angle 90$. Use Smith Chart.