

Adv. Microwave Engg.

QP Code : MV-19072

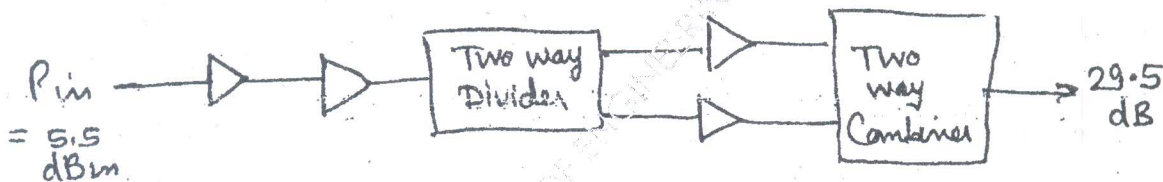
(3 Hours)

[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

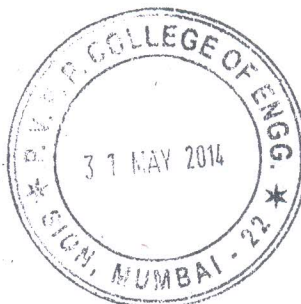
Amplifier	Go(dB)	Gi(dB)	PidB(dBm)
1	8	7	27
2	10	9	22



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 matrix 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. 10
 What is congruence transformation ?

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

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

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

5. (a) Discuss various mixer topologies. Compare performance of various topologies. 10
 (b) Discuss generalised single ended mixer design approach. 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 $Z_0 = 50 \Omega$. Find condition of reciprocity.

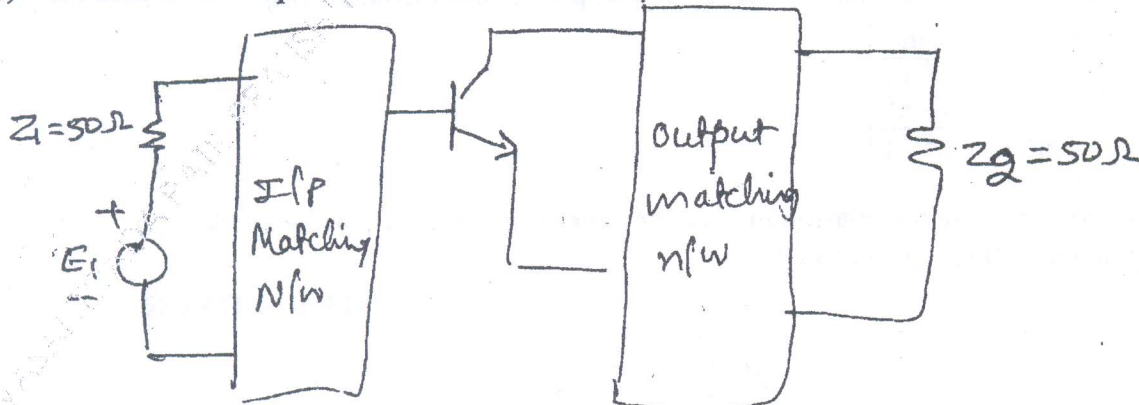
- (b) Discuss generator tuning networks for microwave oscillators. 10
7. (a) A GaAs FET is biased for minimum noise figure and has following S parameters and noise parameters at 4 GHz ($Z_0 = 50 \Omega$). 15

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

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

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 networks 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.

