EC 2403 -RF & MICROWAVE ENGINEERING
BRANCH/YEAR/: ECE/IV

UNIT -2
RF TRANSISTOR AMPLIFIER DESIGN AND MATCHING NETWORKS

PART A

1. What are the key parameters used to evaluate the performance of an amplifier? Key parameters of amplifier, to evaluate its performance are
   1. Gain and gain flatness
   2. Operating frequency and bandwidth
   3. Output power
   4. Power supply requirements
   5. Input and output reflection coefficients
   6. Noise figure

2. Define transducer power gain.

Transducer power gain is nothing but the gain of the amplifier when placed between source and load.

G_T= Power delivered to the load / Available power from the source

3. Define unilateral power gain.

It is the amplifier power gain, When feedback effect of amplifier is neglected i.e. $S_{12} = 0$.

4. Write the function of matching networks?

Matching networks can help stabilize the amplifier by keeping the source and load impedance in the appropriate range.

5. What is the function of matching networks?

Input and output matching networks are needed to reduce undesired reflections and improve the power flow capabilities.

6. Write short notes on feedback of RF circuits.

(i) If $|\Gamma|>1$, then the magnitude of the return voltage wave increases called positive feedback, which causes instability (Oscillator).

(ii) If $|\Gamma|<1$, the return voltage wave is totally avoided (amplifier). It's called as negative feedback.

7. Define unconditional stability.

Unconditional stability refers to the situation where the amplifier remains stable for any passive source and load at the selected frequency and bias conditions.

8. Define noise figure.

Noise figure F is defined as "the ratio of the input SNR to the output SNR".

F= Input SNR / Output SNR

9. Mention the important of the matching network.
   1. Minimum power loss in the feed line
   2. Maximum power delivers (or) Transfer
   3. Improving the S/N ratio of the system for sensitive receiver components
   4. Reducing amplitude & phase errors in a power distribution network
   5. Minimum reflection in transmission line
   6. Optimal efficiency

10. What are the approaches used to a matching network?
   (i) Derive the values of the elements analytically
   (ii) Rely on the smith chart as a graphical design tool

11. Define loaded quality factor.

The loaded quality factor is equal to the ratio of the resonance frequency to the 3 dB bandwidth.

$$Q_l=f_0/BW$$

12. Define nodal quality factor.

Nodal quality factor is defined as the ratio of the absolute value of the reactance to the corresponding resistance.

$$Q_n=X_S/R_S$$

13. What is the advantage of T and Pi matching network?

The addition of the third element into the two element matching network introduces an addition degree of freedom in the circuit and allows us to control the value of ql by choosing appropriate intermediate impedance for wider bandwidth.

14. Why we go for double stub matching networks?

One of the main drawbacks of single stub matching network is that they require a variable length transmission line between the stub and the input port, or between the stub and the load impedance. Usually, this does not a problem for fixed networks, but may create difficulties for variable tuners.

15. What is need of matching network?

Matching networks can help stabilize the amplifier by keeping the source and load impedances in the appropriate range.

16. Name the factor which is used for selecting a matching network.
   1. Complexity
   2. Bandwidth Requirement
   3. Adjustability
   4. Implementation

17. Mention the advantage of Smith chart.

The smith chart allows immediately observing whether or not a particular impedance transformation is capable of achieving the desired matching. Moreover, the total number of possible network configurations can be readily be seen.

PART - B

1. A microwave transistor has the following S parameters at 10 GHz, with 50Ω reference impedance.

S_{11} =0.45	150˚
S_{22} = 0.01	-10˚
S_{12} = 2.05	10˚
S_{21} = 0.40	-150˚

The source impedance is Z_S = 20 Ω and load impedance is Z_L = 30 Ω, compute the power gain, available gain and the transducer power gain (16)

2. Explain the following
   (i) Impedance matching networks (8)
   (ii) Microstripline matching networks (8)

3. Discuss various aspects of amplifier – power relation for RF transistor amplifier design.(16)

4. Explain the various stabilization methods and stability considerations for RF transistor amplifier design. (16)

5. What is the need of impedance matching? Explain in brief single stub matching. State the important expression related to it. (16)

6. A).Write a note on strip line and microstrip line matching.(8)
   B).Describe the frequency response of a quarter – wave transformer (8)

7. Explain in detail about microstrip lines and derive the expression for characteristic impedance of microsrip lines. (16)

8. Discuss in detail about the various losses in microstrip lines. (16)

9. Explain the different types of microstrip lines and give a brief note of their characteristics. (16)