

EC 2403 RF & MICROWAVE ENGINEERING



A.R. ENGINEERING COLLEGE, VILLUPURAM

ECE DEPARTMENT

QUESTION BANK

**SUB. NAME: RF & MICROWAVE ENGINEERING
SEM: VII**

SUB. CODE: EC 2403

BRANCH/YEAR/: ECE/IV

UNIT – 1

TWO PORT RF NETWORKS- CIRCUIT REPRESENTATION

1. What is RF?
2. What is an RF tuner?
3. Define two port networks?
4. Define IEEE standard Frequency Band Designations.
5. Define Microwave Frequency Band Designations.
6. What are the types of microwave devices?
7. What are the Solid-state devices used at RF and microwave frequencies?
8. What are the Applications of Microwave Solid-State Devices?
9. What are the Applications of Microwave?
10. What are the general properties of two port network?
11. Define Impedance parameters (z-parameters)?
12. Define Admittance parameters (y-parameters)?
13. Define Hybrid parameters (h-parameters).
14. Define ABCD-parameters .
15. Define Scattering parameters (S-parameters).
16. Define Scattering transfer parameters (T-parameters).
17. Difference between passive and active devices?
18. What are the properties of passive network?
19. What is the exception to the "passive rule" about not adding energy?
20. Define Lossless networks
21. Define Lossy networks
22. Define 2-Port S-Parameters.
23. What are the properties of 2-Port S-Parameters?
24. What are the types of Transmission lines used in RF and microwave circuits?
25. Draw the block diagram of RF transmitter and receiver of a wireless Communication system.
26. What are the various reasons for using microwaves?
27. What are the disadvantages of microwaves?
28. What are effects of microwave in a circuit that is not available in low frequency AC/DC?
29. Where is stray capacitance presence?
30. Where is stray inductance presence?
31. Define skin effect.
32. Why radiation occurs in microwave frequency?
33. What are the types of microwave hardware?

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34. What are the characteristic features of microwave?
 35. Define scattering transfer parameters.

PART-B

1. (a) A shunt impedance Z is connected across a transmission line with characteristics impedance Z_0 . Find the S matrix of the junction. (8)
 (b) List and explain the properties of S parameters. (8)
2. The S parameters of a two port network are given by

$$S_{11} = 0.2 \angle 0^\circ, S_{22} = 0.1 \angle 0^\circ$$

$$S_{12} = 0.6 \angle 90^\circ, S_{21} = 0.6 \angle 90^\circ,$$
 - (i) Prove that the network is reciprocal but not lossless. (8)
 - (ii) Find the return loss at port 1 when port 2 is short circuited. (8)
3. Derive the formulation of the S – parameters. (16)
4. Derive the S – matrix representation of multiport network. (16)
5. Write short notes on
 1. Reciprocal networks and lossless networks (8)
 2. The transmission (ABCD) Matrix (8)
6. A). Compare the relationship between $[S]$, $[Z]$ and $[Y]$ matrices. (8)
 B). Explain about LF parameters. (8)
7. A). Explain the interrelationship between LF & HF parameters. (8)
 B). Explain about RF basic components and application of RF. (8)

UNIT -2**RF TRANSISTOR AMPLIFIER DESIGN AND MATCHING NETWORKS**

1. Define Transducer power gain.
2. Define Unilateral power gain (G_{TU}).
3. Define Available power gain (G_A).
4. Define Operating power gain (G).
5. Define Available power.
6. Define Stability circles.
7. Give the condition for stability circle.
8. Define Input stability circle equation.
9. Define Output stability circle equation.
10. Define Input and Output circle radius for stability equation?
11. Define Unilateral Figure of Merit.
12. Define Noise Figure Circles.
13. Define impedance matching networks.
14. Define unconditional stability.
15. Define noise parameter.
16. What are the advantages of matching network?
17. What are the designing methods in matching network?
18. Define analytical method.
19. What are the advantages of graphical method?
20. Define nodal factor (Q_n).

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21. What are factors affected the stability circle?
22. What is the practical draw back in unilateral design approach?
23. Define bilateral design.
24. What is simultaneous conjugate match?
25. Define Minimum Noise Figure and its equivalent noise resistance.
26. Define constant VSWR circles in bilateral approach.
27. What is mean by wavelength towards generator?
28. What are the types of matching components?
29. What are key considerations for selection of networks?
30. Define Micro strip line matching network.

PART - B

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

$$\begin{aligned} S_{11} &= 0.45 \angle 150^\circ \\ S_{22} &= 0.01 \angle -10^\circ \\ S_{12} &= 2.05 \angle 10^\circ \\ S_{21} &= 0.40 \angle -150^\circ \end{aligned}$$

The source impedance is $Z_S = 20 \Omega$ and load impedance is $Z_L = 30 \Omega$, 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 microstrip 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)

UNIT – 3
MICROWAVE PASSIVE COMPONENTS

1. Define s-matrix
2. What are the .Properties of s-matrix?
3. Why is s-matrix used in MW analysis?
4. Give ABCD matrix for a two port network

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5. What is ABCD matrix?
6. What are the advantages of ABCD matrix?
7. What is the Scattering matrix for N port device? . .
8. Give the S matrix of uniform transmission line
9. Give the properties of impedance [x]&admittance[y] matrix?
10. For a loss less junction all the elements in the impedance &admittance matrices are
11. What are the properties of scattering matrix for a lossless junction?
12. What is transmission matrix?
13. Define one port circuit. Give two examples.
14. Write the voltage matrix for an N-port microwave circuits.
15. For reciprocal media, the impedance and admittance matrices are
16. For non-reciprocal media,the impedance and admittance matrices are
17. Give two examples for two port junctions.
18. State the unique property of Scattering matrix?
19. Write the scattering matrix for a ideal waveguide section?
20. What are the various reasons pertaining to the wide use of microwaves?
21. What are the two types of terminations?
22. What are ferrites and give its properties?
23. Give some examples of ferrite devices?
24. List two microwave devices using faraday rotation principles.
25. What are power dividers?
26. What is the S-matrix of 3 port circulators?
27. Give the differences between Isolator and Circulator
28. What is the S-matrix for 4 port circulators?
29. Give the S-matrix of E-plane Tee.
30. Give the S-matrix of H-plane Tee.
31. Give the S-matrix of Magic Tee.
32. Give the Smatrix of directional coupler.
33. Give an example for a two port MW device.
34. Give the applications of directional coupler
35. What is Faraday's rotation law?
36. Define VSWR
37. What is Gyrator?
38. What is the principle of Microwave phase shifter?
39. What are junctions? Give some examples
40. What is Tee junction? Give two examples
41. What is the other name for magic TEE?
42. What is hybrid ring?
43. What is the other name for Hybrid ring?
44. Name some wave guide components used to change the direction of the guide through an arbitrary angle
45. What are the different types of Directional coupler?
46. What are hybrid couplers?
47. What are nonreciprocal devices? Give two examples
48. Why isolators are called uniline?
49. Give some coupling parameters of directional coupler?

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1. a). A three port circulator has an insertion loss of 1db, isolation of 20 db, VSWR=1.2 when all ports are matched terminated. Find S matrix and output power at port 2 and 3 for an input power of 100mw at port. (6)

b). Explain the principle of operation of magic Tee and derive the S matrix of Magic Tee. (10).

2. From the first principles derive the S matrix parameters of Directional coupler. (16)

3. a) Is it possible to match all the 3 ports of a lossless reciprocal microwave component? Prove the same. (10)

b) Explain with diagrams waveguide corner, bends, twists. (6)

4. a) What is an isolator? Write down S parameters. (4)

b) A signal of power 32mw is fed into one of the collinear ports of a lossless H plane tee. Determine the powers in the remaining ports when other ports are terminated by means of matched load. (12)

5. With relevant equations, explain the properties of S-matrix with corresponding proof. (16)

7. A four port network has the scattering matrix shown below

$$S = \begin{pmatrix} 0.1 \angle 90^\circ & 0.8 \angle -45^\circ & 0.3 \angle 45^\circ & 0 \\ 0.8 \angle -45^\circ & 0 & 0 & 0.4 \angle 45^\circ \\ 0.3 \angle -45^\circ & 0 & 0 & 0.6 \angle -45^\circ \\ 0 & 0.4 \angle 45^\circ & 0.6 \angle -45^\circ & 0 \end{pmatrix}$$

(i) Is this network lossless? (2)

(ii) Is this network reciprocal? (2)

(iii) What is the return loss at port 1 when all other ports are terminated with matched loads? (4)

(iv) What is the insertion loss and phase dialog between ports 2 and ports 4, when all other ports are terminated with matched loads? (4)

(v) What is the reflection coefficient seen at port 1 in a short circuit is placed at the terminal plane of port 3, and all other ports are terminated with matched loads?(4)

8. Discuss the structure and principle of operation of

(i) Isolator (8)

(ii) Circulator (8)

9. (a). Derive scattering matrix of E – plane tee using S – parameter theory. (8)

(b). what is hybrid ring? With the help of a neat diagram explain its working principle. (8)

9. What do you mean by S parameters? Why do we require S parameters? Draw the diagram of a directional

coupler and explain the working. Derive S matrix of a directional coupler. (16)

10. (a). Derive scattering matrix of H – plane tee using S – parameter theory. (8)

(b). with neat diagrams explain waveguide corners, bends and twists. (8)

11. (a). Derive scattering matrix of E – plane tee using S – parameter theory. (8)

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- (b). draw and explain the concept of N port scattering matrix. (8)
12. What are ferrites devices? Explain in detail the different ferrite devices.(16)

UNIT -4
MICROWAVE SEMICONDUCTOR DEVCES

1. What are the Key phenomenon taking place in TRAPATT diode?
2. What is the operating frequency of TRAPATT devices?
3. What are the applications of TRAPATT devices?
4. What are the applications of Tunnel Diode?
5. What are the elements that exhibit Gunn effect?
6. What are the applications of Gunn Diode?
7. What is negative resistance?
8. What are the applications of Backward diode?
9. Why are FET's preferred to bipolar transistor at high frequencies?
10. What is the main advantage of TRAPATT over IMPATT?
11. Draw the schematic diagram of PIN diode?
12. What is MESFET?
13. Explain stable amplification mode.
14. What are the factors reducing efficiency of IMPATT diode?
15. Explain plasma formation in TRAPATT diode.
16. What is negative resistance in gunn diode?
17. What are the applications of GaAsMESFET.?
18. What are the applications of TRAPATT?
19. What is Transferred electron effect?
20. What are time parameter for TED'S
21. What are the various modes of transferred electron oscillators?
22. List the type of circuit used for IMPATT diode circuits.
23. What are the applications of low Q-oscillators and amplifier circuits?
24. List some of power detecting elements?
25. What is microwave detector?
26. Differentiate baretter and thermistor?
27. Define GUNN EFFECT.

PART - B

1. What is negative resistance in gunn diode? Describe the operation of GUNN diode.(16)
2. What is Transferred electron effect? Explain some of the TED's?(16)
3. a) Using RWH theory, explain two valley model of GaAs.(8)
b) Explain different types of modes.(8)
4. Explain the working principle of IMPATT diode and derive the power output and efficiency?(16)
5. Explain the working principle of TRAPATT diode and derive the power output and efficiency? (16)
6. Explain the working principle and modes of microwave bipolar transistor (16)
7. Explain the working principle and operation of microwave FET. (16)
8. Write a brief note on the different types of materials and list their characteristics,(16)
9. Discuss in detail about the fabrication techniques of MMIC circuits.(16)

EC 2403 RF & MICROWAVE ENGINEERING**UNIT – 5
MICROWAVE TUBES AND MEASUREMENTS**

1. What are the high frequency effects in conventional tubes?
2. What are the assumptions for calculation of RF power in Reflex Klystron?
3. What is the condition for oscillation in Reflex klystron ?
4. Give the drawbacks of klystron amplifiers.
5. What is the effect of transit time?
6. What are the applications of reflex klystron ?
7. What is the purpose of slow wave structures used in TWT amplifiers?
8. How are spurious oscillations generated in TWT amplifier? State the method to suppress it.
- 9 State the applications of TWT.
10. How the klystron amplifier can act as klystron oscillator? What are the applications of klystron amplifier?
11. Define phase focusing effect.
12. What do you mean by O-type tubes? Name some O-type tubes.
13. Define Transit time in Reflex klystron.
14. Write the parameters on which bunching depend on?
15. Compare TWTA Klystron amplifier
16. Give the performance Specification of Reflex klystron?
17. What is CFA? State the applications of CFA.
18. State the characteristics of magnetron and of 2-cavity klystron amplifier.
19. What are the advantages of TWT?
20. What is meant by strapping?
21. State the applications of magnetrons. why magnetron is called as cross filed device?
22. What is BWO? State the applications of BWO.
23. What is hull cutoff condition?
24. What are the principal limitations of conventional negative grid electron tubes?
25. What is frequency pulling and frequency pushing in magnetrons?
26. What are the applications of High Q-oscillators and amplifier circuits?
27. What are tunable detector?
28. What is slotted section with line carriage?
29. What is the main purpose of slotted section with line carriage?
30. What is a VSWR meter?
31. What is Bolometer?
32. What is calorimeter?
33. Mention the disadvantages of single bridge circuit ?
34. Define insertion loss?
35. How will you determine the vswr and return loss in reflecto meter method?
36. List the different types of Impedence measurement methods?
37. How do you measure microwave frequency?
38. What is a wavemeter?
39. Define dielectric constant?
40. How the S-parameter of a microwave circuit measured?
41. List the methods for measuring dielectric constants?
42. What is radiation pattern?
43. What is radiation efficiency?
44. How do you measure the polarization?
45. What is spectrum analyzer?

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46. List the types of spectrum analyzer
47. List some application of spectrum analyzer.
48. What is network analyzer?

PART - B

1. With neat circuit diagrams and relevant equations, explain the velocity modulation process and bunching in a klystron amplifier?(16)
2. Explain in detail about 2-cavity klystron amplifier.(16)
3. Explain in detail about multicavity klystron amplifiers. (16)
4. Derive the equation for power output and efficiency of two cavities and four cavity klystron amplifiers. (16)
5. With neat diagrams and relevant equations, explain about helix traveling wave tube.(16)
6. With neat diagrams and relevant equations, explain about cylindrical and coaxial magnetron. (16)
7. Discuss in detail about tunable magnetron and also explain in brief regarding Ricke diagram. (16)
8. Explain in detail the measurement of VSWR through return loss measurements.(16)
9. Discuss in detail the power measurement using microwave devices.(16)
10. Write a brief note on insertion loss and attenuation measurements.(16)
11. . Explain in detail about the dielectric constant measurement of a solid using waveguide.(16)
12. Discuss in detail the impedance measurement using microwave devices.(16)
13. Derive the equation for power output and efficiency of two cavities and four cavity klystron amplifiers. (16)\
14. . With neat diagrams and relevant equations, explain about helix traveling wave tube. (16)
15. With neat diagrams and relevant equations, explain about cylindrical and coaxial magnetron. (16)
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