QUESTION BANK

MICROWAVE AND ANTENNA ENGINEERING

Subject Code: BTEC-603-18

Faculty: Dr. Mandeep Kaur

Unit 1: Microwave Tubes and Solid-State devices: Limitations of Conventional tubes, construction, Operation and properties of Klystron Amplifier, reflex Klystron, Magnetron, Travelling Wave Tube (TWT), Backward Wave Oscillator (BWO), Crossed field amplifiers. Microwaves Transistors: (Bipolar, FET), Transferred Electron Devices (Gunn diode), Avalanche transit time effect (IMPATT, TRAPATT), Microwave Amplification by Stimulated Emission of Radiation (MASER).

Unit 2: Microwave Components and Measurements: Analysis of Microwave components using S-parameters, Junctions (E, H, Hybrid), Directional coupler, Bends and Corners, Microwave posts, S.S. tuners, Attenuators, Phase shifter, Ferrite devices (Isolator, Circulator, Gyrator), Cavity resonator, Matched termination. Power measurements using calorimeters and bolometers, Measurement of Standing Wave Ratio (SWR), Frequency and wavelength.

2 Mark Questions

1. What is the frequency range of microwave? What limits the frequency of Microwaves?
2. Distinguish between velocity modulation and current modulation.
3. What is electron bunching? How does it occur? Why is it also called intensity Modulation?
4. Define coupling factor& Directivity in case of a directional coupler.
5. Differentiate E-plane Tee & H-plane Tee.
6. What is Hull cut off field?
7. What is phase focusing effect in magnetron?
8. What is a slow wave structure and why is it required?
9. What are reentrant cavities?
10. What is the purpose of strapping in magnetron?

11. What is Hull-voltage in a magnetron?

12. In what type of application reflex klystron is preferred & why?

13. List two discriminations between conventional tube and microwave tube.

14. What is repeller protection & why is it required?

15. What is the need of slow wave structure in TWT?

16. Justify the names-control grid, screen grid, suppressor grid.

17. What is transit time? Why it becomes a limiting factor at lug her frequencies?

18. Discuss different types of vacuum tubes in lieu of their strengths and weakness.

19. List various methods of beam focusing in TWT'S

20. What is Velocity Modulation?

21. What do you understand by current modulation?

22. In what type of applications reflex klystron is preferred & why?

23. List at least two discriminations between Klystron & TWT's.

24. What are ferrites?

25. Why is hybrid Tee also called magic Tee?

26. Why is it named magic tee also? Give construction and working in detail.

27. What are conventional tubes?

28. What is PIN?

29. What is SWR?

30. Write a note on TWT microwave tube.

31. Discuss various ferrite devices in detail.

32. How can the microwave components be analyzed using s-parameters?

4/5 Mark Questions:

33. What are the various UHF limitations of vacuum tubes which limit their use at

high frequencies? Describe each of these in detail and suggest remedial measures.

34. What is Faradays rotation? Give the construction and working of devices based on this phenomenon.

35. What is electron bunching? How does it occur? Why it is also called intensity modulation?

36. What can be the possible solutions to the limitations of conventional tubes at high frequencies? Which one is the best?

37. Enlist the advantages of microwave frequencies over lower frequency waves.

38. Discuss the problem of transit time effect in tubes at microwave frequencies?

39. What is a directional coupler? Give the construction of 2-hole directional coupler.

40. Discuss the behavior of ferrites in isolators and circulators.

41. Explain the working of H-plane Tee.

42. Why are attenuators needed? Why they are not a trivial part of the test setup?

43. Differentiate b/w fixed and variable attenuators.

44. Discuss insertion loss and attenuation measurement.

45. What is a BWO? Explain its performance characteristics.

46. What are the applications of BWO?

47. Explain the function of magic Tee as a duplexer.

48. Explain the function of magic Tee as a mixer.

49. Differentiate between primary and secondary waveguides.

50. Explain the following terms in context of directional couplers: Coupling factor, Directivity, Isolation

51. Explain the working of isolator with the help of neat and clean diagram.

52. Derive the equation for efficiency of two cavity klystron amplifier.

53. Differentiate between reflex klystron and magnetron in detail.

54. Write a note on crossed field amplifier.

10/8 Mark Questions

55. Compare the multi-cavity klystron, reflex klystron, magnetron and Traveling wave tube on the basis of their
    a) Basic construction
    b) Operation
    c) Applications

56. Explain the construction and working of a multicavity klystron.

57. Describe the ∏-mode of operation of magnetron. Discuss bunching phenomenon as well. Draw neat diagrams wherever required.

58. Elaborate the concept of velocity modulation, current modulation and bunching with reference to klystron (two cavity)

Unit 3: Antennas: Concept of radiation in Single wire, Two wire and Dipole, Introduction to Antenna parameters: Reflection Co-efficient, VSWR, Radiation pattern, Directivity, Gain. Infinitesimal dipole, Monopole and half wave dipole, Far-field, Radiating near-field and reactive near-field regions, Microstrip Patch & Fractal Antennas.

Unit 4: Antenna Arrays and Aperture Antennas: Array of two-point sources, Array factor, Array configurations, Hansen-woodyard end fire array, n-element linear array with uniform amplitude and spacing, n-element linear array with non-uniform spacing, Binomial and Dolph-Tschebysceff array. Aperture Antennas: Rectangular and circular aperture antennas, Horn antenna, Babinet's Principle, Slot Antenna, Loop antenna.

2 Mark Questions

Define:

1. Radiation Intensity
2. Beam efficiency
3. Directivity
4. Aperture efficiency
5. Gain
6. Beam solid angle
7. Antenna Beam width
8. What are reflector antennas?
9. What is the difference between directive gain and directivity of antenna?

10. Difference between antenna bandwidth and beam width.
11. Attenuation

12. Distinguish between far field and near field.

13. Define scanning array.

14. Write down the reasons for using an antenna array in practice

15. What is the difference between power gain and directive gain?

16. What is the relation between effective area and directivity of antenna?

17. In end fire array in what direction there is a maximum radiation?

18. Explain near field and far field regions

4/5 Mark Questions

19. What do you mean by Radiation Pattern? Explain with the help of suitable diagram.

20. What are the different types of Apertures?

21. Define phase center of a horn antenna.

22. Differentiate between power gain and directive gain of an antenna.

23. Define the working of slot antenna.

24. Define Babinet's principle.

25. Define Radiation Pattern of an antenna.

26. What are the applications of aperture antenna?

27. Obtain the expression for the beam width of broadside and end fire arrays and compare them.

28. What is the importance of array factor?

29. With the help of diagram differentiate rectangular and circular aperture antenna

30. What is need fcr an antenna array? Distinguish : Broadside and End fire arrav.

31. Outline the principle of working of a phased array.

32. What is an antenna array? Explain the behavior of broadside and end fire antenna array in detail.

33. Differentiate between Ordinary end-fire array and Hansen-Wood Yard end-fire antenna.

34. Derive the equations for BWFN and directivity of broadside array?

10/8 Mark Questions

35. Discuss the construction and operation of loop antenna.

36. What are the applications of aperture antenna?

37. Explain the special features of horn antenna and discuss on its different types with neat diagram.

38. For an array of n isotropic point sources radiating in broadside direction, derive and obtain the maxima and minima direction for a major and minor lobes. Sketch the pattern.

39. Derive the expression for the radiated fields from a short dipole antenna and hence obtain the values of radiation resistance.

40. What is Dolph-Chebyshev distribution for linear broadside array? Show that the distribution gives a minimum side lobe level for a given beam width of major lobe.

41. Derive an expression for radiation pattern of End fire, uniform linear array of four equally spaced isotropic antennas. Also calculate HPBW of its major lobe.

42. Derive the expression for direction of pattern maxima and minima for array n isotropic sources of equal amplitude and spacing (for broadside).