SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code : Microwave Engineering (16EC425) **Course & Branch**: B.Tech – ECE

Year & Sem: III-B.Tech & II-Sem **Regulation:** R16

UNIT-I

Microwave Transmission Lines

1. (a) Discuss how the microwave spectrum is categorized into different bands. **[L6][CO1][6M]**
   (b) Discuss how the microwave spectrum is categorized into different bands. **[L6][CO1][6M]**
2. (a) Explain the wave impedance of a rectangular waveguide and derive the expression for the wave impedance of TE and TM modes. **[L2][CO1][8M]**
   (b) Calculate the cut-off frequency of the following modes in a square waveguide 4 cm × 4 cm TE10, TM11 and TE22. **[L4][CO1][4M]**
3. (a) Show that a waveguide works like a high pass filter. **[L1][CO1][7M]**
   (b) A waveguide having dimensions a = 5 cm, b = 2 cm. The signal applied to waveguide is10GHz. Determine the modes that are propagating in the waveguide. **[L5][CO1][5M]**
4. Derive the expressions for the field components due to TE waves in rectangular wave guide. **[L4][CO1][12M]**
5. Explain following terms (a) Guide wavelength (b) Phase Velocity (c) Group Velocity. **[L2][CO1][12M]**
6. (a) Show that TM01 and TM10 modes in a rectangular waveguide do not exist. **[L1][CO1][6M]**
   (b) For a wave guide having cross section 3cm × 2cm, compute the cut-off frequency in the TE01 mode. Also, calculate the phase velocity and guide wavelength at a frequency equal to 50% above the cut-off frequency. **[L4][CO1][6M]**
7. (a) Why TEM modes are not possible in hollow rectangular waveguide? Prove it. **[L1][CO1][6M]**
   (b) When dominant mode propagated in air filled circular waveguide diameter is 4cms. Find cut-off wavelength, cut-off frequency and guide wavelength. **[L1][CO1][6M]**
8. (a) Define Cavity Resonator. Draw Diagrams of Rectangular & circular cavity Resonators. **[L1][CO1][4M]**
   (b) Derive the equation for resonant frequency in circular cavity resonator. **[L4][CO1][4M]**

9. (a) Derive the equation for Resonant frequency in rectangular cavity resonator. **[L4][CO1][7M]**

   (b) Calculate resonant frequency of rectangular cavity filled with dielectric with ϵ_r=4 and having dimensions a=5cm b=4cm and d=15cm **[L4][CO1][5M]**

10. (a) Discuss in detail about Q factor of cavity Resonator. **[L6][CO1][6M]**

    (b) A wave guide operating in TE10 mode has dimensions a = 2.26 cm and b = 1 cm. The measured guide wave length is 4 cm. Find

    i. Cut off frequency of the propagating mode

    ii. The frequency of operation

    iii. Maximum frequency of propagation in this mode. **[L4][CO1][6M]**

UNIT-II

Waveguide Components And Applications

1. (a) Explain the coupling mechanism of waveguide. **[L2][CO2][6M]**

   (b) Explain the following (i) Waveguide windows (ii) Screws. **[L2][CO2][6M]**

2. Explain the following (a) precision Variable attenuator (b) rotary vane attenuator. **[L2][CO2][12M]**

3. Explain following terms (a)E-plane Tee (b) H-plane Tee (c) Magic Tee **[L2][CO2][12M]**

4. (a) Draw a typical directional coupler and define directivity and coupling coefficient. **[L2][CO2][7M]**

   (b) An 20db directional coupler gives 3dbm in output power through coupled port. If the Isolation specified as 55 dB, find the power available at the Isolated Port. **[L2][CO2][5M]**

5. What is the principle of phase shifter? Draw the diagram of dielectric phase shifter and discuss the working mechanism. **[L1][CO2][12M]**

6. Explain following terms (a) Gyrator (b) Isolator. **[L2][CO2][12M]**

7. (a) What is meant by normalized voltage and normalized current with respect to the microwave circuit concept. Draw a neat sketch of a Magic Tee and obtain its S matrix. **[L1][CO2][7M]**

   (b) List and Explain two applications of Magic Tee. **[L1][CO2][5M]**

8. (a) Derive the S-matrix for E-plane junction. **[L4][CO2][6M]**

   (b) Explain the principle of Ferrite phase shifter. **[L1][CO2][6M]**

9. (a) Derive the S-matrix for Magic Tee junction. **[L4][CO2][6M]**

   (b) A 20 dB coupler has a directivity of 30 dB. Calculate the value of isolation. **[L4][CO2][6M]**

10. (a) Derive the S-matrix for directional coupler. **[L1][CO2][6M]**

(b) Using the properties of scattering matrix of a lossless, reciprocal microwave junction, prove that for a four port network if all the four ports are matched, the device shall be a directional coupler. **[L5][CO2][6M]**

UNIT – III
Microwave Tubes

1. (a) Give the performance specification of Reflex klystron. **[L1][CO3][6M]**

(b) Define and explain current modulation with neat diagrams and required expressions. **[L1][CO3][6M]**

2. Describe with a neat sketch the constructional details and principle of operation of a reflex klystron tube. **[L2][CO3][12M]**
3. (a) Write any two limitations of conventional tubes at Microwave frequencies. **[L1][CO3][6M]**

(b) With the help of velocity diagram explain principle of two-cavity Klystron amplifier. **[L1][CO3][6M]**

4. Discuss in detail about Reflex Klystron and Calculate efficiency. **[L6][CO3][12M]**
5. (a) List discriminations between conventional tube and microwave tube. What can be the possible Solutions to the limitations of conventional tubes at high frequencies? Which one is the best? **[L1][CO3][6M]**

(b) Write short notes on bunching process in a two-cavity klystron amplifier. **[L1][CO3][6M]**

6. Explain the operation of a two cavity klystron amplifier. Derive expressions for bunched beam current and efficiency. **[L1][CO3][12M]**
7. What are slow wave structures? Explain how a helical TWT achieve amplification. **[L1][CO3][12M]**
8. (a) Explain the possibility of oscillations in a TWT amplifier. **[L1][CO3][6M]**

(b) Discuss about the differences between a TWT and a Klystron. **[L6][CO3][6M]**

9. (a) Write short notes on wave modes. **[L1][CO3][6M]**

(b) Mention how a TWT can be converted to an oscillator. Explain the operation of such a device. Why large tuning range, are possible with such a device? **[L2][CO3][6M]**

10. (a) Derive the expressions for propagation constant and output power gain of TWT. **[L1][CO3][6M]**

(b) In an O-type traveling wave tube, the acceleration voltage is 4000 V and the magnitude of the axial electric field is 4 V/m. The phase velocity on the slow wave structure is 1.10 times

the average electron velocity. The operating frequency is 2 GHz. Determine the magnitude of velocity function. **[L5][CO3][6M]**

UNIT – IV
M-Type Tubes

1. Explain the growth of oscillations in a travelling wave magnetron. **[L1][CO4][12M]**
2. Discuss in detail about cylindrical magnetron. **[L1][CO4][12M]**
3. (a) Explain the properties of high field domain for microwave generation and amplification. **[L1][CO4][6M]**

   (b) Explain the rate of growth of space charge layers with the help of necessary expressions. **[L1][CO4][6M]**
4. (a) What is transferred electron effect? **[L1][CO4][6M]**

   (b) Explain clearly how a GUNN diode is different from a tunnel Diode Both A & B being a negative resistance devices. **[L1][CO4][6M]**
5. (a) What is parametric amplifier? **[L1][CO4][6M]**

   (b) Explain it as an amplifier and frequency converter. **[L1][CO4][6M]**
6. (a) Explain the V-I characteristics of a Gunn diode. **[L1][CO4][6M]**

   (b) List the differences between microwave transistor and TED devices. **[L1][CO4][6M]**
7. (a) Give the classification of solid state microwave devices along with examples? **[L1][CO4][6M]**

   (b) An n-type GaAs Gunn diode has following parameters:

   Electron drift velocity: $v_d = 2.5 \times 105$ m/s.

   Negative electron mobility: $\mu_n = 0.015$ m^2/ v. s.

   Relative dielectric constant: $\epsilon_r = 13.1$.

   Determine the criterion for classifying the modes of operation. **[L5][CO4][6M]**
8. Discuss how a decrease in drift velocity with increasing electric field can lead to the formation of a high field domain for microwave generation and amplification. **[L6][CO4][12M]**
9. (a) Discuss in detail about Gunn diode modes of operation. **[L6][CO4][6M]**

   (b) What are bulk properties of a GUNN diode that give rise to negative resistance like characteristics? **[L1][CO4][6M]**
10. (a) Explain Two Valley Model Theory. **[L1][CO4][6M]**

    (b) Write short notes on “TRAPATT diode”. **[L1][CO4][6M]**

UNIT – V

Microwave Measurements

1. (a) Distinguish between low frequency measurement and microwave measurements. **[L4][CO5][6M]**

   (b) With the help of a neat sketch, briefly explain the functions of different blocks of a microwave bench. **[L1][CO5][6M]**

2. (a) Discuss about the important considerations when making attenuation measurement. **[L6][CO5][6M]**

   (b) Explain about measurement of attenuation using a microwave bench setup **[L1][CO5][6M]**.

3. (a) Discuss in detail about measurement of VSWR. **[L6][CO5][6M]**

   (b) Determine s-parameters of a 10 dB directional coupler of directional coupler of Directivity 30 dB. Assuming directivity of coupler loss-less VSWR at each port under Matched condition is unity. **[L5][CO5][6M]**

4. (a) What is spectrum analyzer? List the types of spectrum analyzer. List some application of Spectrum analyzer. **[L1][CO5][6M]**

   (b) Describe a microwave bench. **[L1][CO5][6M]**

5. (a) How to measure an attenuation of a given microwave signal? **[L1][CO5][6M]**

   (b) What is VSWR? Explain the method measurement for low and high VSWR? **[L1][CO5][6M]**

6. (a) Distinguish between the terms: Insertion Loss and Attenuation. With a neat set up, describe the method of measurement of attenuation using a waveguide bench. **[L4][CO5][6M]**

   (b) Write short notes on usage of Isolator and its significance in a microwave bench. **[L1][CO5][6M]**

7. (a) Write a short note on power ratio method. **[L1][CO5][6M]**

   (b) Write short notes on RF substitution method. **[L1][CO5][6M]**

8. (a) Two identical directional couplers are placed in a waveguide to sample the incident and the reflected power. The meter readings show that the power level of the reverse coupler is 10dB down from the level of the forward coupler. What is the value of the SWR on the waveguide? **[L1][CO5][6M]**

   (b) How are microwave measurements different from low frequency measurements? **[L1][CO5][6M]**

9. (a) Draw the experimental setup necessary for the measurement of impedance using slotted line. Explain in detail. **[L2][CO5][6M]**

(b) What are the characteristics of detectors used in microwave measurement. **[L1][CO5][6M]**

10. (a) Discuss in detail about measurement of attenuation. **[L6][CO5][6M]**

(b) Write short notes on "Reflection co-efficient and Insertion loss measurement at microwave frequencies" **[L1][CO5][6M]**

Prepared by: **Y.Murali & G.Leena kumari**