QUESTION BANK

Academic Year : 2018 - 2019
Department : ECE
Year/Semester : III ECE II Semester
Regulation : R16
Subject Code : Microwave

Unit-1

1. a) Show that TM01 and TM10 modes does not exist in a rectangular waveguide.
b) A rectangular wave guide with dimension of 8X4 cm operates in the TM11 mode at 10Ghz.Determine the characteristic wave impedance.

2) a) Derive the characteristic wave impedance of TEmn modes in a rectangular wave guide and obtain the relation b/w the guided wave length and characteristic impedance.
b) An air filled rectangular wave guide of inside dimensions 3X2 cm operates in the dominant TE10 mode (i) find cutoff frequency fc (ii) phase velocity of wave at a frequency of 3.5Ghz (iii) guided wave length at the same frequency.

3) a) Describe the method of designating the modes of transmission in rectangular wave guides. What is dominant mode and why it is most often used in wave guides. [10+6]
b) Define group velocity and phase velocity of a rectangular wave guide

4) a) Derive the expression for cutoff frequency, phase constant phase velocity, group velocity and wave impedance in rectangular wave guide. [8+8]
b) Derive the expression = Where _g guide wave length and _c is cutoff length for rectangular wave guides

5) a) Derive the TEmn mode field equations in a rectangular waveguide..
b) Show that TM01 and TM10 modes do not exist in a rectangular waveguide

6) a) An air-filled rectangular wave guide has dimensions of a = 6 cm and b = 4 cm. The signal frequency is 3 GHz. Compute cutoff frequency, Guide wavelength, Phase constant and group velocity for the following modes i) TE10 ii) TE01 iii) TE11 iv) TM11
b) Obtain the expressions for average power transmitted through a rectangular wave guide for TEmn and TMmn modes.

7) a) The dominant mode TE10 is propagated in a rectangular waveguide of dimensions a=6 cm and b= 4 cm. The distance between a maximum and a minimum is 4.47cm. Determine the signal frequency of the dominant mode.
b) What are dominant and degenerate modes? What is the significance of dominant modes? Indicate the dominant mode in rectangular wave guide and calculate fc for the same.

8) a) An air filled rectangular waveguide shown in figure below transports energy in TE10 mode at the rate of 0.5 hp. Calculate the peak value of the electric field in the guide at 30 GHz.
b) Derive the TMmn mode field equations in a rectangular waveguide. (6+10)

unit-2

1 a)What is a cavity resonator? Discuss the applications of cavity resonator
b) Derive the expression for resonator frequency of rectangular cavity resonator

2 a) Derive the expression for resonant frequency of a rectangular cavity resonator.
b) An air filled circular waveguide has a radius of 2 cm and is to carry energy at a frequency of 10GHz. Find all the TE and TM modes for which energy transmission is possible.

3 a) Explain why TEM mode does not exist in a circular wave guide.
b) What is the significance of Q in resonant circuits? Derive a general expression Q for a series resonant circuit what happens to Q when circuit is loaded.

4 a) Discuss the advantages and disadvantages of microstrip lines.
b) A circular waveguide operating in the dominant mode at a frequency of 9 GHz with a maximum field strength of 300 V/cm. The internal diameter is 5cm. Calculate the maximum power.

5 a) What are cavity resonators? Derive the equations for resonant frequencies for a rectangular and circular cavity resonators.
b) Calculate the resonant frequency of a circular resonator of following dimensions. Diameter = 12.5cm and length = 5cm for TM012 mode (consider Pmn=2.405 for dominant mode.
c) What do you understand by the quality factor of a cavity resonator? Discuss the term unloaded Q and loaded Q.

6) a) Derive the field expressions for a rectangular cavity resonator. Plot the field patterns forthe dominant mode of propagation in such a resonator for TE and TM moldes.

b) Calculate the lowest resonant frequency of a rectangular cavity resonator of dimensionsa=2cm , b=1cm, d=3cm?(c) Mention one way of coupling energy to a resonator.

7) a) An air-filled circular waveguide has a diameter of 4 cm and is to carry energy at a frequency of 10 GHz. Determine all TEnp modes for which transmission is possible.
b) Define Q factor of a cavity resonator. Derive the expression for Q factor of a cavity resonator

8 a) A TE11 wave is propagating in a air-filled circular waveguide of diameter 10 cm at 3 GHz, find the cutoff frequency, guide wavelength, wave impedance in the guide.
b) With a neat diagram explain the working of a rectangular cavity resonator. Use relevant expressions for fields and obtain the expression for resonant frequency of oscillation.

9 a) A circular wave guide has a cutoff frequency of 9GHz in dominant mode. Find the inside diameter of the guide if it is i) air-filled. ii) Filled with dielectric with _r=4.

b) With a neat diagram explain the working of a cylindrical cavity resonator. Use relevant expressions for fields and obtain the expression for resonant frequency of oscillation.

Unit-3

1 a) Explain the working principle of directional coupler and derive the expression for

directivity and coupling coefficient. [8+8]

b) Write short notes on circulator.

2 a) Explain the principle of working of rectangular wave guide dielectric phase shifter.

b) Write short notes on H plane Tee

3) a) What is an Isolator? What is significance of it and its applications in microwave circuits? [8+8]

b) What is necessity of S matrix representation of microwave components

4) Write short notes on the following :

a) Directional coupler b) Magic Tee

5 a) Write short notes on wave guide discontinuities. [8+8]

b) Derive the S matrix of 3 port circulators.

6) Write short notes on: [8+8]

a) Wave guide phase shifter b) Flap attenuator

7) a) What is a directional coupler? Derive the S matrix of a 4-port directional coupler.

b) Derive the S matrix of a magic Tee

8) a) What is the effect of discontinuity in a waveguide? Discuss in detail

b) How many types of waveguide phase shifters do you know? Discuss one type in detail.

c) Write a short note on resonant Iris.

9) a) Explain the action of isolator, gyrator and circulator using ferrites. Mention their typical applications.

b) What are ferrites? Why are these useful in microwaves? Mention their properties.

c) Define Faraday rotation.

10) a) Briefly explain the following:

(i) Posts (ii) Turning screws (iii) Waveguide attenuators (iv) Waveguide joints

b) Determine the [S] of a three port circulator for a given insertion loss of 0.5dB, isolation of 20dB and VSWR of 2

11) a) Derive the scattering matrix for isolator, gyrator and circulator. Mention their typical applications too.

b) In an H-plane Tee junction, 20mW power is applied to port 3 that is perfectly matched to the junction. Calculate the power delivered to the load 60_ and 75_ connected to ports 1 and 2.

12) a) Explain the action of Rat-Race junction

b) Discuss in detail about single hole and double hole directional coupler.
c) Write a short note on coupling mechanisms.

13. a) Derive the S matrix for directional coupler.
b) Show that the sum of the terms of any column of the S matrix of a lossless network when multiplied by the complex conjugate of the corresponding terms of any other column is zero.

14) a) Explain probe and loop coupling mechanisms with neat sketches.
b) A 90 W power source is connected to the input of a directional coupler with C=25 dB, D=35 dB and insertion loss =0.5 dB. Find the output powers at the through, coupled and isolated ports.

15) a) Obtain the scattering matrix of a directional coupler.
b) What is Faraday rotation? Explain the principle operation of a Gyrator using relevant diagrams

16) a) Explain types of aperture coupling with neat sketches.
b) Explain the working of a dielectric phase shifters with neat sketch

7) a) Obtain the scattering matrix of a 3-port circulator .Given insertion loss of 0.5 dB, isolation of 20 dB and VSWR of 2.
b) Explain the principle of a hybrid ring

unit-4

1) a) Explain the working of Reflex klystron with neat Applegate diagram. [8+8]
b) Derive the expression for the efficiency of a 2cavity klystron amplifier

2) a) What is velocity modulation? Explain how amplification takes place in two cavityklystron amplifier. [10+6]

b) What is transit time? What is its significance in microwave tubes?

3 a) Derive the expression for output power and efficiency of a 2 cavity klystron. [8+8]
b) Explain the operation of reflex klystron oscillator with a neat diagram.

4 a) Draw the mode curves of Reflex klystron and derive the relation between mode number and repeller in Reflex klystron. [8+8]
b) Describe the non degenerate negative resistance parametric amplifier

5 a) What is velocity modulation? How is it different from normal modulation? Explain how velocity modulation is utilized in klystron amplifier.
b) A two cavity klystron is operated at 10GHz with V0 =1200V, I0=30mA, d=1mm, L=4cm and Rsh=40K _. Neglecting beam loading, calculate

(i) Input RF voltage V1 for a maximum output voltage
(ii) Voltage gain and

(iii) Efficiency

6 a) Draw a schematic diagram of a two-cavity klystron amplifier. With the help of an Applegate diagram, explain how an amplification is achieved?

b) A two-cavity klystron amplifier has the following parameters:

Beam voltage V0 = 900V

Beam current I0=30mA

Frequency f =8GHz

Gap spacing in either cavity d = 1mm

Spacing between centers of cavities L = 4cm

Effective shunt impedance Rsh=40K_

Determine:

(i) The electron velocity
(ii) The dc electron transit time
(iii) The input voltage for a maximum output voltage
(iv) The voltage gain in decibels

7 a) List and discuss the applications and limitations of Reflex klystron and Two-cavity klystron.

b) A Reflex klystron oscillator has V0=2500V, L = 6mm and f=3GHz. Calculate the repeller voltage for which the tube can oscillate in 1 ¾ mode and 3 ¾ mode

c) Write a short notes on Reentrant cavities.

8 a) Name the different methods of generating microwave power. Describe with necessary theory about the working of a reflex klystron oscillator. Explain how frequency stabilization is achieved in this tube?

b) Briefly explain the limitations and losses of conventional tubes at microwave frequencies

unit-5

1 a) Explain how amplification takes place in Helix TWT? [8+8]

b) What is Hartee condition in Magnetron?

2. a) What is magnetron? Explain the principle of operation of it with a neat sketch.

b) What is a slow wave structure? What are its applications? [10+6]

3 a) With a neat sketch explain the structure and principle of operation of TWT amplifier.

b) How is bunching achieved in a cavity magnetron? Explain. [8+8]

4. a) Explain the significance of slow wave structure in the amplification process. List out the major differences b/w TWT and klystron. [8+8]

b) Explain the operation of 8 cavity magnetron

5 a) Mention how a TWT can be converted to an oscillator? Explain the operation of such a device. How is large tuning range possible with such a device?

b) A Helical TWT has a diameter of 2mm with 50 turns per cm. Calculate the axial phase velocity and the anode voltage at which the TWT can be operated for useful gain.

6. a) What are the different slow wave structures? Explain how a helical TWT achieves amplification?
b) Discuss the necessity of strapping in magnetrons?

7 a) Write a brief note on the following:
(i) _ mode operation of magnetron (ii) slow wave structures
b) Discuss the performance of magnetrons and list the important applications.

Unit-6

1) a) Explain the principle of operation and characteristics of GUNN diode. [8+8]
b) Explain the operation of IMPATT diode with neat diagram.

2. a) Explain the procedure for measuring VSWR<10 [8+8]
b) Explain the procedure for measuring attenuation with neat diagram.

3. a) What are the bulk properties of GUNN diode that give rise to negative resistance?
b) Draw the equivalent circuit of parametric amplifier and explain the parametric involved. [8+8]

4. a) Write short notes on microwave frequency measurements. [8+8]
b) Draw a neat sketch of a MW test bench for impedance measurements.

5. a) Describe a non degenerative resistance parametric amplifier. [8+8]
b) What is TRAPATT diode? How it is better than IMPATT diode.

6. a) Explain the procedure for measuring VSWR>10 using microwave test bench. [8+8]
b) Write short notes on reflection coefficient and insertio

.

7. a) Explain the physical structure and construction of IMPATT diodes. [8+8]
b) Compare IMPATT and TRAPPAT diodes.

8. a) Give the measurement procedure for measuring Q factor of resonant cavity. [8+8]
b) Define VSWR. Describe the methods for measuring

9) a) what is avalanche Transit time devices? Explain the operation, construction and applications of the following devices:
(i) IMPATT
(ii) TRAPATT
b) Explain the Gunn effect using the two valley theory.

10) a) Draw the block diagram of a microwave setup for measurement of high microwave powers and explain the procedure.
b) Explain any two methods of measuring microwave frequency.

Discuss the several donation formation modes of a Gunn diode.
c) Mention the typical characteristics and applications of a Gunn diode.

11. a) Give the block diagram for the measurement of impedance at microwave frequencies and explain the procedure.

b) Explain the principle of power measurement using Bolometric method

12) a) An IMPATT diode has a Cj of 0.05pF and Lp of 0.5nH, Cp is negligible. If the breakdown voltage is 100V and the bias current is 100mA. Determine the resonant frequency and efficiency. Assume the RF peak current as 0.8A and RL as 2_.

b) Discuss in brief about RWH theory.

c) Discuss the merits and demerits of IMPATT diode.