Code No: V5220/R07

Set No: 1

III B.Tech II Semester Regular & Supplementary Examinations, April/May - 2012

MICROWAVE ENGINEERING

(Electronics and Communications Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

*****

1. a) Derive the TE_{mn} mode field equations in a rectangular waveguide..
   b) Show that TM_{01} and TM_{10} modes do not exist in a rectangular waveguide. (10+6)

2. 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 TE_{np} 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+8)

3. 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. Assume all ports to be matched. (8+8)

4. a) Obtain the scattering matrix of a directional coupler.
   b) What is Faraday rotation? Explain the principle operation of a Gyrator using relevant diagrams. (8+8)

5. a) Draw the equivalent circuit of a reflex klystron and discuss electronic admittance in detail. Use relevant expressions and plots. Mention the performance characteristics of reflex klystron.
   b) A reflex klystron is operated at 5 GHz with an anode voltage of 1000V and cavity gap of 2 mm. Find out the optimum length of the drift region. Assume N. V_R=500V. (10+6)

6. Explain the construction working of a TWT. Derive the expression for gain of a TWT. (16)

7. a) Explain Gunn effect using two valley theory and explain J-E characteristics of Gunn diode.
   b) Explain domain formation using relevant diagrams in Gunn diode. (8+8)

8. a) Draw the block schematic of a typical microwave bench and explain the functionality of each component.
   b) Explain the measurement of power using bolometer method. (8+8)

*****

Code No: V5220/R07

Set No: 2

III B.Tech II Semester Regular & Supplementary Examinations, April/May - 2012

MICROWAVE ENGINEERING

(Electronics and Communications Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

*****

1. 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) TE_{10} ii) TE_{01} iii) TE_{11} iv) TM_{11}
   b) Obtain the expressions for average power transmitted through a rectangular wave guide for TE_{mn} and TM_{mn} modes. (12+4)

2. a) A TE_{11} 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. (8+8)

3. a) Explain types of aperture coupling with neat sketches.
   b) Explain the working of a dielectric phase shifter using a neat diagram. (8+8)

4. 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 working of hybrid ring. (10+6)

5. a) Discuss the limitations of conventional tubes at microwave frequencies.
   b) By means of applegate diagram explain the operation of reflex klystron. Show that theoretical efficiency of reflex klystron is 27.78%. (6+10)

6. a) What are slow wave structures? Explain how helical TWT achieves amplification.
   b) A helical TWT has diameter of 2 mm with 50 turns per cm. Calculate axial phase velocity and the anode voltage at which the TWT can operated for useful gain. (8+8)

7. Explain the constructional details of a Gunn diode. Explain different modes of operation of Gunn diode. Mention the typical (performance) characteristics of Gunn diode. (16)

8. a)Explain the power ratio method of measurement of attenuation
   b) Explain the method of measurement of high VSWR. (8+8)

*****

Code No: V5220/R07

Set No: 3

III B.Tech II Semester Regular & Supplementary Examinations, April/May - 2012

MICROWAVE ENGINEERING

(Electronics and Communications Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

*****

1. a) The dominant mode TE_{10} 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 f_c for the same. (8+8)

2. 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 ϵ_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. (8+8)

3. a) Explain the principle of operation of rotary vane type attenuator.
   b) Explain the principle of operation of Bethe hole directional coupler. (8+8)

4. a) Obtain the scattering matrix of a H-plane Tee.
   b) Explain the working of dielectric phase shifter. (8+8)

5. a) Explain the contraction and working of two cavity klystron amplifier and also derive the expression for efficiency.
   b) A reflex klystron operates at the peak of mode of n = 2 with V_o=280V, I_o=22mA and signal voltage V_1=30V. Determine the efficiency. (10+6)

6. Explain the construction and working of 8 cavity cylindrical magnetron. Derive Hull's Cutoff Voltage equation. (16)

7. Explain the construction, schematic and working of IMPATT diode. Use necessary V- I characteristics. Draw the doping profiles of a typical IMPATT diode. (16)

8. a) Explain the RF substitution method of measurement of attenuation.
   b) Explain the measurement of low VSWR. (8+8)

*****

Code No: V322/R07

Set No: 4

III B.Tech II Semester Regular & Supplementary Examinations, April/May - 2012

MICROWAVE ENGINEERING

(Electronics and Communications Engineering)

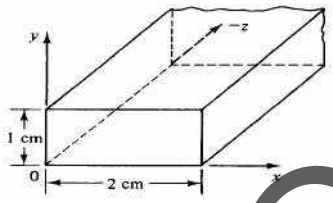
Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

*****

1. a) An air filled rectangular waveguide shown in figure below transports energy in TE_{10} 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 TM_{mn} mode field equations in a rectangular waveguide. (6+10)

2. a) An air-filled circular waveguide has a radius of 3 cm and is used as a resonator for TE_{01} mode at10 GHz by placing two perfectly conducting plates at its two ends. Determine the minimum distance between the two end plates.
b) Explain the significance of Q factor of a cavity resonator. Draw the equivalent circuit of a cavity coupled to a generator. Define coupling coefficient K. Explain the types of coupling coefficients giving loaded Q for every type. (6+10)

3. a) Explain the principle of operation two hole directional coupler. Define coupling coefficient, directivity, insertion loss and indicate the values for an ideal directional coupler.
b) What are waveguide posts? Draw the equivalent circuits of waveguide posts of lengths □λ/4, = λ/4, □λ/4 and explain the behavior using a graph susceptance versus distance of the post into the guide. (10+6)

4. a) What are s-parameters? Why are s-parameters preferred at microwave frequencies? Write the properties of scattering matrix.
b) Draw the constructional details of isolator and explain the working of isolator. (8+8)

5. a) A reflex klystron operates at the peak of the n = 2 mode. The dc power input is 40mW and the ratio of V_1 over V_o is 0.278. If 20% of power delivered by the beam is dissipated in the cavity walls, find the power delivered to the load. (V_1 = Signal Voltage and V_o=Beam voltage)
b) Explain the construction and working of two cavity klystron amplifier. (6+10)

6. a) Explain the terms frequency pulling and frequency pushing with reference to magnetron.
b) What is mode jumping in magnetrons and explain remedial measures to overcome it.
c) Compare the performance characteristics of TWT amplifier and Magnetron. (4+6+6)

Code No: V5220/R07

Set No: 4

7. What are avalanche transit time devices? Explain the schematic and working of TRAPATT diode. Use necessary voltage and current waveforms. Indicate typical values of power output and efficiency. (16)

8. a) Explain the measurement of Q of a cavity resonator.
   b) Explain the frequency measurement techniques. (8+8)

*****