Code No: R32042 **R10** **Set No: 1**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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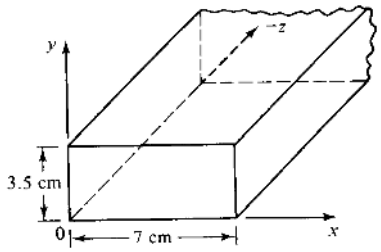
1. a) An air-filled rectangular wave guide of inside dimensions 7 x 3.5 cm shown below operates in dominant mode, find the cutoff frequency also determine phase velocity and guided wavelength at 4GHz.

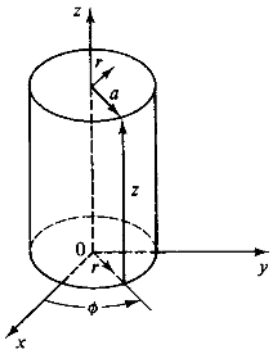


b) Explain three different cases for propagation constant in rectangular waveguide.

c) Discuss different power losses in rectangular waveguide using necessary expressions.

(5+5+5)

2. a) TE_{11} mode is propagating through a circular guide of radius 4 cm shown in figure below which is filled with air dielectric . Determine cutoff frequency, guide wavelength at 4 GHz and wave impedance in the guide.



b) Write the properties of TEM modes in a lossless medium.

c) Explain different types of coupling coefficients using necessary expressions. Also draw a curve to represent the relationship between coupling coefficient and standing wave ratio.

d) With the help of diagrams explain the methods of excitation of modes in a rectangular cavity resonator. (5+3+4+3)

3. a) Draw a neat diagram of a two hole four port directional coupler indicate through port, coupled port for any given input port. Explain its principle of operation.
   b) Explain different probe coupling mechanisms.
   c) Explain the construction and working of E-plane Tee. (4+4+7)

4. a) A directional coupler has 10 dB coupling coefficient and 40dB directivity, insertion loss of 1 dB. For an input power of 10mW at the input port of the main arm, determine the power at different ports. Other ports except the one at which the measurement is made are match terminated.
   b) Explain why h, Y and Z parameters cannot be measured at microwave frequencies.
   c) What is Faraday rotation? Explain the working of a Gyrator with neat diagrams. (4+3+8)

5. a) With reference to a two cavity klystron amplifier explain the term velocity modulation and derive velocity modulation equation. Also describe the effect of transit angle on coupling between electron beam and buncher cavity.
   b) Describe the power output and frequency characteristics of reflex klystron. Also derive the expression for efficiency of reflex klystron. (8+7)

6. a) Classify *M*-type tubes and write about them in brief.
   b) Compare the performance characteristics of magnetron and klystron oscillator.
   c) Derive the expression for power gain of a helical TWT. (5+3+7)

7. a) What is Gunn effect?
   b) Explain the constructional details of a Gunn diode.
   c) Explain different modes of operation of Gunn diode. (3+4+8)

8. a) Explain the measurement of Q of a cavity resonator.
   b) Explain different frequency measurement techniques. (7+8)

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Code No: R32042 **R10** **Set No: 2**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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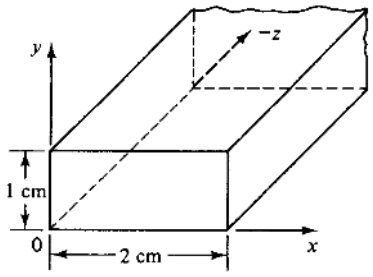
1. a) An air filled rectangular waveguide with a cross-section 2x1 cm transports energy in the TE_{10} mode. The impressed frequency is 20 GHz .Write the field components and find β_g.



b) Derive the expressions for average power transmitted through rectangular wave guide for TE_{mn} and TM_{mn} modes.

c) Discuss propagation of TM modes in rectangular waveguides using necessary field expressions. (5+5+5)

2. a) A circular wave guide has a cutoff frequency of 6 GHz in dominant mode. Find the inside diameter of the guide if it is i) air-filled ii) filled with dielectric with $\varepsilon_r = 3$.

b) Explain why hollow conductors do not support TEM propagation where as a coaxial conductor does?

c) Explain the geometry of a circular cavity resonator, write the field equations and obtain the expression for its resonant frequencies for TE and TM modes. (5+3+7)

3. a) Explain the behavior of waveguide post of different lengths compared to λ/4. Use susceptance versus distance curve to explain.

b) Explain the principle of operation of rotary vane type attenuator.

c) Explain the construction and working of H-plane Tee. (5+5+5)

4. a) A 20 mW signal is fed to one of the collinear port1 of a lossless H-plane Tee. Calculate the power delivered through each port when other ports are match terminated.

b) Write the properties of scattering matrix.

c) Explain the construction and working of a ferrite circulator with neat diagrams. (5+3+7)

5. a) Classify *O*- Type tubes and mention their suitable applications, frequency range of operation, average power that can be generated, gain , efficiency and bandwidth.
   b) Explain the lead inductance and inter electrode capacitance effects in conventional vacuum tubes.
   c) Draw the equivalent circuit of a reflex klystron and discuss electronic admittance in detail. (4+5+6)

6. a) Write the differences between TWT and Klystron.
   b) What is the use of a slow wave structure in TWT and write about different types of slow wave structures.
   c) Draw the schematic diagram of a cylindrical magnetron and derive the expressions for Hull cutoff magnetic equation. (3+4+8)

7. a) What are avalanche transit time devices?
   b) Draw and explain the schematic and working of TRAPATT diode. Use necessary voltage and current waveforms.
   c) Explain J-E characteristics of Gunn diode and indicate negative resistance region (3+8+4).

8. a) Explain the RF substitution method of measurement of attenuation.
   b) Explain the measurement of low VSWR. (8+7)

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Code No: R32042 **R10** **Set No: 3**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Find the cutoff frequency for the TE_{10} mode in a rectangular waveguide with dimensions 4x2 cm. Also find the guide wavelength and phase velocity at a frequency of 25 percent higher than cutoff frequency.
   b) What does the suffixes m and n indicate in TE_{mn} mode representation? Sketch the electric and magnetic field distributions for TE_{10} in rectangular waveguide.
   c) Derive the field equations for transverse electric mode in rectangular wave guide. (4+3+8)

2. a) A circular waveguide is filled with a lossless dielectric $\varepsilon_r = 8$. If the cutoff frequency is 6 GHz, calculate the diameter and find the upper frequency limit over which only the dominant mode will propagate.
   b) Explain the geometry of a rectangular cavity resonator, write the field equations and obtain the expression for its resonant frequencies for TE and TM modes.
   c) Discuss the properties of microstrip lines. (5+6+4)

3. a) Explain the principle of operation of rotary vane type attenuator.
   b) Explain the principle of operation of dielectric phase shifter.
   c) Explain the construction and working of magic Tee. (5+5+5)

4. a) A three port circulator has an insertion loss of 1 dB, an isolation of 20 dB, and a VSWR of 1.2.Find the output powers at port 2 and 3 for an input power of 100mW at port1.
   b) A matched isolator has insertion loss of 0.5 dB and an isolation of 25dB. Find its scattering coefficients.
   c) Explain the construction and working of a ferrite isolator. (5+3+7)

5. a) Explain the process of bunching in a klystron amplifier with relevant expressions and applegate diagram.
   b) Explain the gain-bandwidth product limitation in conventional vacuum tubes. (8+7)

6. a) Write the classification of different types of magnetrons.
   b) Explain the terms frequency pulling and frequency pushing with reference to magnetron.
   c) A helical TWT has diameter of 3 mm with 40 turns per cm. Calculate axial phase velocity and the anode voltage at which the TWT can operated for useful gain. (3+4+8)

7. a) Explain RWH theory with relevant diagrams. (6+9)
   b) Draw the doping profiles of IMPATT diode and explain the principle of operation.

8. a)Explain the power ratio method of measurement of attenuation
   b) Explain the method of measurement of high VSWR. (7+8)

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Code No: R32042 **R10** **Set No: 4**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Justify that TM_{11} is a dominant mode in rectangular waveguide for transverse magnetic propagation. (4+3+8)
   b) List different microwave bands in spectrum, their frequency ranges and mention their applications.
   c) Derive the field equations for transverse magnetic mode in rectangular wave guide.

2. a) An air-filled circular wave guide having an inner radius of 1 cm is excited in dominant mode at 10GHz. Find the cutoff frequency in dominant mode, guide wavelength, wave impedance and bandwidth for operation in dominant mode.
   b) Define Q-factor of a cavity resonator and obtain an expression for it.
   c) Explain the characteristics of TM_{np} modes in circular waveguides. Obtain necessary field equations. (5+5+5)

3. a) Explain types of aperture coupling with neat sketches.
   b) Explain the working of a rotary vane type shifter using a neat diagram.
   c) Explain the application of magic Tee as an isolator using relevant diagrams. (6+6+3)

4. a) A reciprocal two-port microwave device has a VSWR of 1.5 and an insertion loss of 2dB. Find the magnitude of s-parameters of the device.
   b) Explain the construction and working of a ferrite circulator with neat diagrams.
   c) Obtain the scattering matrix of a E-plane Tee. (3+7+5)

5. a) Explain velocity modulation of a reflex klystron and derive the expression for round trip transit time in the repeller region.
   b) Explain the transit-angle effects in conventional vacuum tubes.
   c) Explain electronic tuning of Reflex klystron. (8+4+3)

6. a) Derive the Hartee anode voltage equation for magnetron.
   b) How many modes of propagation are possible in *O*-type TWT and obtain the propagation constants for them. Also explain nature of waves in these modes. (7+8)

7. a) Explain domain formation using relevant diagrams in Gunn diode.
   b) Draw and explain the schematic and working of TRAPATT diode. Use necessary voltage and current waveforms. (7+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. (7+8)

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