Code No: V3220 **R07** **Set No: 1**

III B.Tech. II Semester Supplementary Examinations, December - 2012

Microwave Engineering

(Electronics & Communications Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

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1 a) Define phase and group velocities . Derive the relationship between phase and group velocities. Present the physical interpretation of phase and group velocity.

b) A rectangular waveguide is designed to propagate the dominant mode TE_{10} at a frequency of 5GHz. The cutoff frequency is 0.8 times the signal frequency. The ratio of the guide height to width is 2. The time-average power flowing through the guide is 1KW. Determine the magnitudes of electric and magnetic intensities in the guide and indicate where these occur in the guide.

2 a) An air-filled circular waveguide has a radius of 1.5 cm and is to carry energy at a frequency of 10 GHz. Find all TE and TM modes for which transmission is possible.

b) Derive the field expressions for a cylindrical cavity resonator.

3 a) Explain the principle of operation of E-H plane Tee. Explain why E-H plane Tee is called a magic Tee.

b) Explain the working of resistive card type of waveguide attenuator.

4 a) Can all three ports of a 3 port circulator be perfectly matched ? Derive the necessary conditions to justify the answer.

b) Explain the principle operation of a Gyrator using relevant diagrams.

5 a) Define reentrant cavity and draw the available types. Discuss the characteristics and an application of a reentrant cavity.

b) A reflex klystron operates at the peak of the n=1 or ¾ mode. The dc power input is 40mW and the ratio of V_1 over V_o is 0.278. Determine the efficiency of reflex klystron and the total power in mW. (V_1 = Signal Voltage and V_o=Beam voltage)

6 a) Compare the performance characteristics of magnetron,TWT and klystron oscillator.

b) A TWT operates under the following parameters beam current is 5omA, beam voltage is 2.5kV, circuit length is 45, f is 8GHz, Z_o is 6.75Ω. Determine gain parameter, power gain, all four propagation constants.

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.

8. Explain the methods for measurement for low and high microwave powers.

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Code No: V3220 **R07** **Set No: 2**

III B.Tech. II Semester Supplementary Examinations, December - 2012

Microwave Engineering

(Electronics & Communications Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

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1 a) The electric field intensity of the dominant TE_{10} mode in a lossless rectangular wave guide is $E_y = E_0 \sin\left(\frac{\pi x}{a}\right) e^{-j\beta g^z} \quad for > f_c$

Find the magnetic field intensity **H** also Compute the cutoff frequency and the time-average transmitted power.

b) Show that it is impossible for a TEM wave to propagate in a rectangular wave guide.

c) Wave guide acts like a high pass filter. Comment on the validity of this statement and justify your answer.

2 a) An air-filled circular waveguide is to be operated at a frequency of 6 GHz and is to have dimensions such that $f_c = 0.8*f$ for the dominant mode. Determine the diameter of the guide and the wavelength λ_g and the phase velocity v_g in the guide

b) Describe the various ways of coupling energy to a resonator.

3 a) What are matched terminations and explain types of such terminations available with neat sketches.

b) Explain the working of a rotary vane type phase shifter using a neat diagram.

4 a) A signal of power 40mW is fed to one of the collinear ports of a lossless E-plane Tee .

Determine the powers in the remaining ports when other ports are terminated by means of

matched loads.

b) Obtain the scattering matrix of magic Tee.

5 a) Draw the sketch representing modes of operation of a reflex klystron and explain the relevant terms associated. Explain how oscillations are sustained in a reflex klystron oscillator.

b) A two cavity klystron has the following parameters: beam voltage =900V,beam current=30mA,frequency=8GHz,gap spacing in either cavity = 1mm,spacing between centers of cavities =4cm,effective shunt impedance=40kΩ. Determine the electron velocity, dc electron transit time, input voltage for maximum output voltage and voltage gain.

Code No: V3220 **R07** **Set No: 2**

6 a) Why strapping is needed in magnetron? How is the same effect obtained without strapping?
b) Discuss the performance of magnetrons.
c) An *O*-type travelling wave operates at 8GHz. The slow-wave structure has a pitch angle of 4.4^{o} and an attenuation constant of 2 Np/m. Determine the propagation constant of the tube.

7 Explain Gunn effect using two valley theory and explain J-E characteristics of Gunn diode and also explain domain formation using relevant diagrams in Gunn diode.

8 a) Explain the method of measurement of impedance using slotted line.
b) Explain the method of measurement of high VSWR.

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Code No: V3220 **R07** **Set No: 3**

III B.Tech. II Semester Supplementary Examinations, December - 2012

Microwave Engineering

(Electronics & Communications Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

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1 a) The dominant mode TE_{10} is propagated in a rectangular wave guide of dimensions a=2.25 cm and b=1 cm. Assume an air dielectric with a breakdown gradient of 30kV/cm and a frequency of 10 GHz. There are no standing waves in the guide. Determine the maximum average power that can be carried by the guide.

b) Derive the TM_{mn} mode field equations in a rectangular waveguide.

2 a) An air-filled circular waveguide of 2cm inside radius is operated in the TE_{01} mode . Compute the cutoff frequency. If the guide is to be filled with a dielectric material of ε_r =2.25, to what value must its radius be changed in order to maintain the cutoff frequency at its original value?

b) What are cavity resonators? Derive the expressions for resonant frequencies of rectangular and cylindrical cavities.

3 a) Explain the principle of operation of hybrid ring using relevant diagrams and also obtain its scattering matrix.

b) Explain the working of dielectric phase shifter

4 a) Determine the scattering parameters for a 10 dB lossless directional coupler. Given that directivity is 30dB and VSWR at each port is 1 under matched conditions. Designate the ports in the main guide as 1 or 2 and the ports in the auxiliary guide as 3 and 4.

b) Explain the principle of operation of Bethe hole directional coupler using relevant diagrams.

5 a) Explain the construction and working of two cavity klystron amplifier and also derive the expression for efficiency.

b) A reflex klystron operates under the following conditions: beam voltage=500V, shunt resistance=20kΩ, f_r=8GHz,spacing between repeller and cavity=1mm and the tube is oscillating at f_r at the peak of the n=2 mode or 1(3/4) mode . Neglecting transit time through the gap and beam loading effect , find the repeller voltage, dc current density to give microwave gap voltage of 200V and electronic efficiency.

Code No: V3220 **R07** **Set No: 3**

6 a) An *O*-type travelling wave operates at 2GHz. The slow-wave structure has a pitch angle of 5.7^{o}.Assuming lossless tube determine the propagation constant.
b) What is back heating? How can it be avoided?
c) What are cross field devices ? Consider Π mode and explain how does a magnetron sustain its oscillations using the cross field.

7 Explain in detail the schematic and working of TRAPATT diode.

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

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Code No: V3220 **R07** **Set No: 4**

III B.Tech. II Semester Supplementary Examinations, December - 2012

Microwave Engineering

(Electronics & Communications Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

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1 a) A TE_{11} mode of 10 GHz is propagated in an air-filled rectangular waveguide. The magnetic field in the z direction is given by $H_z = H_0 \cos\left(\frac{\pi x}{\sqrt{6}}\right)\cos\left(\frac{\pi y}{\sqrt{6}}\right) \quad A/m$

The phase constant β = 1.0475 rad/cm, the quantities x and y are expressed in cm and a=b= $\sqrt{6}$ are also in cms. Determine the cutoff frequency, phase velocity, guide wavelength and the magnetic field intensity in the y direction.

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.

2 a) A rectangular-cavity resonator has dimensions of a = 5 cm, b = 2 cm and d = 15 cm. Compute the resonant frequency of the dominant mode for an air-filled cavity also of a dielectric filled cavity with ε_r=2.56.

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.

3 a) Explain the principle of operation of two hole directional coupler with neat sketches and relevant terminology. Mention the applications of directional couplers. Indicate the ideal values of different parameters associated with a directional coupler.

b) What are waveguide irises? Draw the equivalent circuits of different waveguide irises and explain their behavior.

4 a) Prove that the sum of the products of each term of any row or column multiplied by the complex conjugate of the corresponding terms of any other row or column is zero.

b) Explain the working of a three port circulator and suggest a means by which it can be used as an isolator.

Code No: V3220 **R07** **Set No: 4**

5 a) A two cavity klystron has the following parameters: beam voltage =30kV,beam current=3A, frequency=10GHz,beam coupling coefficient=1,dc electron charge density = $10^{-7}C/m^3$,signal voltage =15V,cavity shunt resistance=1kΩ, total shunt resistance=10kΩ. Determine the plasma frequency, reduced plasma frequency for R=0.4, induced current and voltage in output cavity, output power delivered to load.
b) Explain the terms electronic and mechanical tuning with reference to RKO
c) Draw the applegate diagram of RKO and explain.

6 a) How is bunching achieved in a cavity magnetron? Explain phase focusing effect.
b) In an *O*-type travelling–wave tube, beam voltage is 3000V,Z_0=10Ω,f=10GHz,beam current=20mA. Determine the propagation constants of the four modes of travelling waves.

7 Explain the construction, schematic and working of IMPATT diode.

8 a) Explain the measurement of impedance using reflectometer.
b) Explain the frequency measurement technique.
c) Explain the significance of slotted line in microwave measurements.

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