Code No: 07A6EC06 **R07** **Set No. 2**

III B.Tech II Semester Examinations,December 2010
MICROWAVE ENGINEERING
Common to Electronics And Telematics, Electronics And Communication Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the concept and merits of a micro strip line transmission.
   (b) Discuss the properties of micro strip lines. [8+8]
2. (a) Draw the characteristics of TRAPATT diode and explain their shape.
   (b) Explain different types of modes for uniformly doped bulk diodes with low resistance contacts. [8+8]
3. (a) What are the high frequency effects in conventional tubes. Explain in detail.
   (b) A two cavity klystron amplifier has the following parameters:
   $V_0 = 1200V. I_0 = 25mA. R_0 = 30k-\Omega, f = 10GHZ, d = 1mm. L = 4cm, Rsh = 30k-\Omega$
   Calculate
      i. Input voltage for maximum output Voltage
      ii. Voltage gain in dB
      iii. Efficiency. [8+8]
4. (a) Define and explain the significance of the following terms as applicable to a directional coupler.
      i. Coupling
      ii. Directivity
      iii. Insertion loss.
   (b) A symmetric directional coupler has an infinite directivity and a forward attenuation of 20 dB. The coupler is used to monitor the power delivered to a load Z_l as shown in figure 4b. Bolometer 1 introduces a VSWR of 2.0 on arm 1; bolometer 2 is matched to arm 2. If bolometer 1 reads 9 mw and bolometer 2 reads 3 mw.

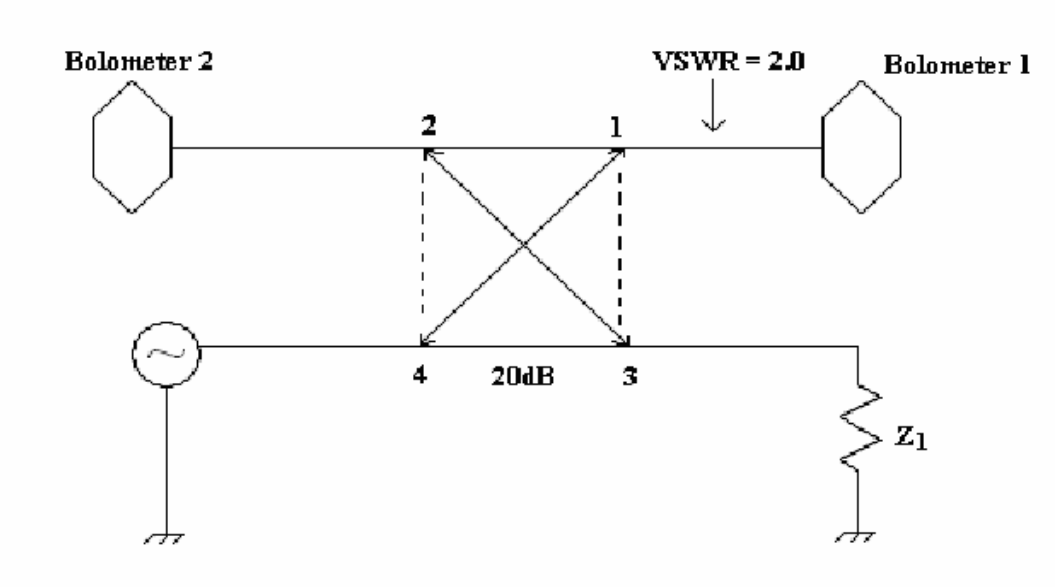

Figure 4b

i. Find the amount of power dissipated in the load Z_I.
ii. Determine the VSWR on arm 3. [8+8]

5. (a) Derive the Hull cutoff Voltage for a magnetron.
   (b) The parameters of a linear Magnetron are: V_o= 12KV,I_o=1.2A,B_o=0.15T, separation between cathode & anode = 4CM. Find the Hulls cutoff Voltage. [8+8]

6. (a) Write the S - matrices for
      i. a simple ideal rectangular wave guide section
      ii. a simple ideal dielectric phase shifter in a rectangular wave guide.
   (b) A reciprocal 2 port microwave network has a VSWR of 1.5 and an insertion loss of 2 dB. Find the magnitudes of S parameters for this circuit. [8+8]

7. (a) Show that wave guide is a high pass filter.
   (b) A rectangular wave guide has dimensions a = 4.5 cm, b = 3 cm and a 9 GHz signal is propagating through it. Calculate cut off wave length, guide wave length group and phase velocities and wave impedance for
      i. Dominant mode
      ii. TM_{11} mode. [8+8]

8. (a) Describe various techniques of measuring unknown frenquency of a microwave generator.
   (b) A slotted line is used in association with an X-band microwave source, When the line is terminated by a short circuit, adjacent nulls are found at position which are shown as 9.27cm and 11.05 cm. What is the value of the guide wavelength. [8+8]

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1. (a) Write a short notes on the "losses occurring in a micro strip lines".
   (b) Show the field configuration in strip and micro strip lines. Compare their properties, merits and demerits. [8+8]
2. (a) Draw E - plane Tee diagram and state its properties.
   (b) Explain the principle of Ferrite phase shifter. [8+8]
3. (a) Describe in detail the RWH theory.
   (b) The IMPATT diode has the following parameters
   Carrier drift velocity: $V_d = 2 \times 10^7$ cm/s
   Drift region length: L = 6 μm
   Maximum operating voltage: V_{omax} = 100 v
   Maximum operating current: I_{omax} = 200 mA
   Efficiency: η = 15%
   Breakdown voltage: V_{bd} = 90V
   Compute
      i. Maximum CW output power in watts
      ii. Resonant frequency in GH_z [8+8]
4. (a) Scattering matrix is a unitary matrix. Prove this statement.
   (b) Obtain the S - matrix for a magic Tee with respect to its properties. [8+8]
5. (a) Explain in detail the effect of parasitic Circuit elements at high frequencies in conventional tubes.
   (b) A two cavity klystron amplifier has the following parameters
   $V_0 = 1000V$ $R_0 = 40k\Omega$
   $I_0 = 25mA$ $f = 3GHZ$
   $d = 1mm$ $L = 4cm$ $R_{sh} = 30k\Omega$
      i. Find the input gap voltage to give maximum voltage.
      ii. Find the voltage gain, neglecting the beam loding in the output cavity.
      iii. Find the efficiency of the amplifier, neglecting beam loading.
      iv. Calculate beam loading conductance & show that neglecting it was justified in the preceding calculations. [8+8]

6. A frequency-agile coaxial magnetron has the following parameters: Pulse duration $\tau = 0.30, 0.60, 0.90\mu$s, duty cycle DC=0.0011 Pulse rate on target N=15/scan. Find
   (a) Agile excurtion.
   (b) The pulse to pulse frequency separation.
   (c) The signal frequency.
   (d) The time for N pulse.
   (e) Agile rate. [16]

7. (a) Obtain the equivalent transmission line circuit representation for TE waves in rectangular metal wave guide.
   (b) Show that $\nabla.E = 0, \nabla.H = 0$ for TE and TM modes in rectangular wave guide. [8+8]

8. (a) Two identical 30dB directional couplers are used to sample incident and reflected power in a wave guide. VSWR=2 and the output of the coupler sampling incident power=4.5mW.What is the value of reflected power.
   (b) Describe a microwave bench. [8+8]

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Code No: 07A6EC06 **R07** **Set No. 1**

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1. Write short notes on :
   (a) Gyrator
   (b) Circulator as isolator. [8+8]
2. (a) Write a short notes on the measurement of frequency using slotted line technique.
   (b) How do you extend the range of power measurement. [8+8]
3. (a) Give the different types & explain the characteristics of slow wave structure.
   (b) A TWT operates with following parameters:
   Vb=2.5KV, Ib=25mA, Z_o=10 Ω, circuit length,L=50,f=9GHz
   Find the gain parameter & power gain. [8+8]
4. (a) A rectangular wave guide of inner dimensions 2.5 cm × 1.2 cm is to propagate energy in TE_{10} mode. Calculate the cut off frequency. If the frequency of signal is 1.2 times this cut off frequency, compute the guide wave length, phase velocity and wave impedance. Derive the relations used.
   (b) Prove that for any wave guide.
   $\frac{1}{\lambda^2} = \frac{1}{\lambda g^2} + \frac{1}{\lambda c^2}$ [8+8]
5. (a) Explain about the principle of operation of TRAPATT diode.
   (b) What are avelenche transmit time devices? Mention the specifications and applications of TRAPATT diodes. [8+8]
6. (a) Derive the expression for Reflex klystron electronic efficiency & draw its admittance spiral diagram.
   (b) A two cavity klystron has the following characteristics:
   Voltage gain : $15d\beta$
   Input power : 5mW.
   Total shunt impedance of input cavity $R_{sh} = 30k\Omega$
   Total shunt impedance of output cavity $R_{sh} = 40k\Omega$
   Load impedance at output cavity $R_l = 40k\Omega$.
   Determine:
      i. Input voltage (rms)
      ii. Output voltage (rms)

iii. Power delivered to the load in watts. [8+8]

7. (a) For TE_{101} mode in a rectangular cavity resonator of width 'a', height 'b' and length 'd', show that the frequency of resonance is given by $f_r = \frac{c}{2d}\sqrt{1+\frac{d^2}{a^2}}$

   (b) Derive an expression for quality factor for a rectangular cavity resonator.[8+8]

8. (a) What is the magic associated with a Magic tee? Illustrate its applications.

   (b) Discuss how wave equations are useful in understanding the propagation of EM waves in wave guides. [8+8]

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Code No: 07A6EC06 **R07** **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. What is Faraday rotation? Explain the working of a ferrite circulator with neat sketches. How can it be used as an isolator? [16]

2. (a) An air field rectangular wave guide has dimensions of a = 6 cm, b = 4 cm. The signal frequency is 3 GHz. Compute the following for TE_{10}, TE_{11} modes.
   i. Cut off frequency
   ii. Wave length in the waveguide
   iii. Phase constant and phase velocity in the wave guide
   iv. Group velocity and wave impedance in the wave guide.
   (b) Discuss the methods of excitations of modes in the rectangular wave guide. [8+8]

3. (a) Describe various losses in micro strip lines.
   (b) A certain micro strip line has the following parameters.
   $\in_r = 5.23$ h = 7 mils t = 2.8 mils w = 10 mils.
   Calculate the characteristic impedance of the line. [8+8]

4. (a) Calculate the SWR of a transmission mode system operating at 10GHz. Assume TE_{10} wave transmission m node a wavelength of dimensions a=4cm, b=2.5 cm.The distance measured between twice minimum power points=1mm on a slotted line.
   (b) Write a short notes on the measurement of low VSWR. [8+8]

5. (a) A reflex klystron operates under the following conditions:
   $V_0 = 600V,\ I_0 = 11.45mA,\ L = 1mm.$
   $R_{sh} = 15k\Omega,\ f_r = 9GHZ.$
   The tube is oscillating at f_r at the peak of n = $1\frac{3}{4}$ mode.
   Assume $\beta = 1$ find
   i. The microwave gap voltage.
   ii. Repeller Voltage for the mode $1\frac{3}{4}$.
   (b) Draw the equivalent circuit of reflex klystron & explain about the electronic admittance of it. [8+8]

6. (a) Show the attenuation produced by rotary vane attenuator is given by - 40 log ($\sin\theta$).

(b) Describe in detail about linear phase changer. [8+8]

7. (a) Derive the expression for power gain in dB for TWT.

   (b) A TWT has following characteristics:
   Beam Voltage V_o 2KV, Beam current Io= 4mA, characteristic Impedance Z_o= 20 Ω ,circuit length, N=50 & frequency f =8 GHz. Find the

   i. gain parameter C

   ii. power gain in db. [8+8]

8. (a) Explain about the principle of operation of TRAPATT diode.

   (b) What are avelenche transmit time devices? Mention the specifications and applications of TRAPATT diodes. [8+8]

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