Code No: RR320404 **Set No.1**

III B.Tech. II Semester Regular Examinations, April/May -2005
MICROWAVE ENGINEERING
(Electronics & Communication Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Show that input admittance of triode circuit is given by $\omega^2\ L_K\ C_{gk}\ g_m$ + jωC_{gk}, considering the inter electrode capacitances, lead inductance.
   (b) Describe the mechanism of velocity modulation in a two cavity Klystron and hence obtain an expression for the bunched beam current?

2. (a) What is a slow wave structure? Explain and differentiate between different structures.
   (b) Explain the working principle of TWT amplifier.

3. (a) A magnetron is operating in the Π mode and has the following specifications, N=10,
   f= 3MHz, a = 0.4cm, b= 0.9 cm, l = 2.5 cm, V_0 = 18 KV, B = 0.2 wb/m^2.
   Determine
      i. the angular velocity of the electron.
      ii. The radius at which radial forces due to electric and magnetic fields are equal and opposite.
   (b) What are Hatree harmonics? Explain in detail.

4. (a) Write short notes on "LSA mode in GUNN diode".
   (b) How is it possible to exhibit negative resistance characteristics in an IMPATT diode?

5. (a) An air filled resonant cavity with dimension a= 5 cm, b= 4 cm and c=10 cm is made of copper ($\sigma_c = 5.8$ x 10^7 mhos/m). It is filled with a lossless material (μ_r =1), ($\in_r$ = 3) Find the resonant frequency f_r and the quality factor for TE_{101} mode.
   (b) Discuss the significance and advantages of dominant mode in rectangular and circular waveguides.

6. (a) State the properties of E plane Tee and H plane Tee.
   (b) Show that a symmetrical magic Tee is a 3dB directional coupler.

7. (a) Derive the S matrix for series Tee using the properties of S parameters.
   (b) A three port circulator has an insertion loss of 1 dB, isolation 30 dB and VSWR = 1.5. Find the S matrix.

8. (a) What are the precautions to be taken while setting up microwave bench for measurement of various parameters.

(b) How do you measure microwave power using a Bolometer.

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1. (a) Explain clearly the different high frequency effects in electron tubes and show how these are eliminated in the design of a high frequency microwave tube.
   (b) The bunching grids of a Klystron amplifier are 2 mm apart. The beam voltage is 2KV and the drift space is 2.8 cm. Long. What must be the value of the rf voltage at the bunching grid to produce a maximum fundamental components of the current at the catcher. Assume the operating frequency is 2.8 GHz. On what factors does the bunching parameter depend upon?

2. (a) With the aid of neat sketches, describe the construction and operation of TWT.
   (b) Starting with the assumption that there are three forward traveling waves in TWT, derive an expression for power gain of the tube.

3. (a) A linear magnetron has the following operating parameters.
   V_0 = anode voltage = 10 KV
   I_0 = cathode current = 1 Amp
   B_0 = Magnetic flux density = 0.01 wb/m^2
   d = distance between cathode and anode = 5cm
   Compute
      i. The hull cut off voltage for a fixed B_0
      ii. The hull cut off voltage for a fixed V_0 explaining the relations in voltage
   (b) Explain why mode separation is necessary and how it is achieved in a normal cylindrical magnetron.

4. (a) Discuss in detail the principle of operation of GUNN diode according to the two valley model theory and sketch its volt-ampere characteristic.
   (b) Describe the operation of an IMPATT oscillator. Comment on its frequency range, power output and noise properties.

5. (a) A rectangular cavity of width 'a' height 'b' and length 'd' is to resonance with TE_{101} mode. Show that the frequency of resonance
   $f_{res} = \frac{C}{2d}\sqrt{1+\frac{d^2}{a^2}}$
   If f_{res} = 10GHz, a= 2 cm., and b = 1cm, find 'd'
   (b) Discuss how wave equations are useful in understanding the propagation of EM waves in wave guides.

6. Write short notes on the following.

(a) Directional couples.

(b) Wave guide windows.

(c) Flap attenuator.

7. Explain the construction, operation and applications of the following microwave components.

   (a) Circulator

   (b) Gyrator.

8. (a) Explain VSWR measurement procedure in microwave laboratory with a suitable microwave bench setup.

   (b) Calculate VSWR of a rectangular guide of 2.3cm x 1.0 cm operating at 8 GHz. The distance between twice minimum power points is 0.09 cm.

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Code No: RR320404 **Set No.3**

III B.Tech. II Semester Regular Examinations, April/May -2005
MICROWAVE ENGINEERING
(Electronics & Communication Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) How does the reflex Klystron work? Discuss its operating characteristics and applications?
   (b) Distinguish between velocity modulation and current modulation. Derive an expression for minimum distance at which maximum bunching occur in Klystron amplifier.
2. With a neat sketch explain the structure and the principle of operation of backward wave oscillator. Derive a simple expression for the oscillator frequency? Discuss its applications
3. (a) A magnetron is operating in the Π mode and has the following specifications, N=10,
   f= 3MHz, a = 0.4cm, b= 0.9 cm, l = 2.5 cm, V_0 = 18 KV, B = 0.2 wb/m^2.
   Determine
      i. the angular velocity of the electron.
      ii. The radius at which radial forces due to electric and magnetic fields are equal and opposite.
   (b) What are Hatree harmonics? Explain in detail.
4. (a) Write short notes on "LSA mode in GUNN diode".
   (b) How is it possible to exhibit negative resistance characteristics in an IMPATT diode?
5. (a) Write short notes on "Cavity resonators"
   (b) Distinguish between TEM, TE and TM modes of the propagation in rectangular wave guides.
6. Write short notes on
   (a) Wave guide Irises
   (b) Rat Race hybrid.
   (c) Dielectric phase shifters.
7. (a) Discuss propagation of microwave energy in ferrites.
   (b) A matched isolator has insertion loss of 0.5 dB and isolation of 25 dB. Find the scattering co-efficients.

8. (a) Explain VSWR measurement procedure in microwave laboratory with a suitable microwave bench setup.

   (b) Calculate VSWR of a rectangular guide of 2.3cm x 1.0 cm operating at 8 GHz. The distance between twice minimum power points is 0.09 cm.

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Answer any FIVE Questions
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1. (a) Describe the phenomenon of velocity modulation in two cavity Klystron and explain how the microwave power is amplified by the interaction of velocity modulated beam with EM field in the two cavity Klystron.
   (b) A reflex Klystron operates at the peak of the n=2 mode. The dc power input is 40mW and $V_1/V_0 = 0.278$. If 20% of the power delivered by the beam is dissipated in the cavity walls, find the power delivered to the load.
2. (a) An O type TWT operates at 2 GHz. The slow wave structure has a pitch angle of 4.4^0 and attenuation constant of 2 Np/m. Determine the propagation constant of the traveling wave in the tube.
   (b) Write short notes on "Helix traveling wave tube"
3. (a) A magnetron is operating in the Π mode and has the following specifications, N=10,
   f= 3MHz, a = 0.4cm, b= 0.9 cm, l = 2.5 cm, V_0 = 18 KV, B = 0.2 wb/m^2.
   Determine
      i. the angular velocity of the electron.
      ii. The radius at which radial forces due to electric and magnetic fields are equal and opposite.
   (b) What are Hatree harmonics? Explain in detail.
4. (a) Discuss the principle of "MASER". And its applications.
   (b) Write short notes on "Parametric Amplifier".
5. (a) An X band waveguide filled with a dielectric is operating at 9 GHz. Calculate the phase and group velocities in the wave-guide. Take $\in_r$ as 2.25 for the dielectric.
   (b) What are cavity resonators? What are their most desirable properties?
6. (a) What is a directional coupler? A 20dB coupler has a directivity of 30dB. Calculate the value of isolation, defining all the forms involved.
   (b) Explain the functioning of "rotary Vane attenuators".
7. Write short notes on
   (a) Properties of S matrix.
   (b) Gyrator and its applications.

8. (a) Explain VSWR measurement procedure in microwave laboratory with a suitable microwave bench setup.

   (b) Calculate VSWR of a rectangular guide of 2.3cm x 1.0 cm operating at 8 GHz. The distance between twice minimum power points is 0.09 cm.

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