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

III B.Tech II Semester Supplementary Examinations,
November/December 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) Discuss the limitations of conventional tubes at microwave frequencies.
   (b) Explain the principle of operation of two cavity Klystron with neat diagrams. [6+10]

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.. [6+10]

3. (a) Explain the growth of oscillations in a traveling wave magnetron.
   (b) Compare the features of rising Sun magnetron with cavity magnetron. [8+8]

4. (a) Describe a non-degenerate negative resistance parametric amplifier.
   (b) An N type Ga As GUNN diode has the following specification
   Threshold field: 3KV/m
   Applied field 3.5KV/m
   Device length 10 micrometers
   Doping Constant 10^{14} electron/ Cm^3
   Operating freq. 10 GHz
   Calculate the current density and (-Ve) electron mobility in the device, explaining the relations used. [6+10]

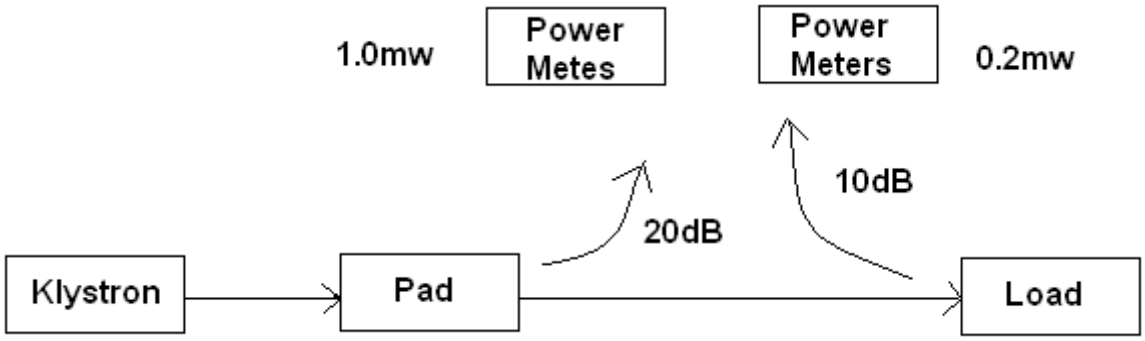
5. (a) An air filled resonant cavity with dimension a= 5 cm, b= 4 cm and c=10 cm is made of copper ($\sigma_c = 5.8$ x 10^7 mhos/m). It is filled with a lossless material (μ_r =1), ($\in_r = 3$) Find the resonant frequency f_r and the quality factor for TE_{101} mode.
   (b) Discuss the significance and advantages of dominant mode in rectangular and circular waveguides. [8+8]

6. (a) Explain
      i. Coupling Probes
      ii. Coupling loops.
   (b) What is a phase shifter? Explain its principle of operation with a neat sketch. Give its applications. [8+8]

7. (a) What are ferrite devices? Explain how Faraday rotation is utilized in the construction of a 4 port circulator.

(b) What are the advantages of scattering matrix representation over impedance and admittance matrix representations? [10+6]

8. (a) A load test is being run with directional coupler as shown below.



Determine

i. Return loss
ii. Magnitude of reflection co-efficient
iii. VSWR

(b) Explain the bolometric method of measuring microwave power. [10+6]

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Code No: RR320404 **Set No. 2**

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

Answer any FIVE Questions
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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? [8+8]

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". [8+8]

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. [8+8]

4. (a) Write short notes on "Parametric up converter".
   (b) What is a MASER? What does its name signify? What applications does it have? [8+8]

5. (a) Find the resonant frequency and wave length for a rectangular cavity operating in theTE_{211} mode if the dimensions of the cavity are a=5cm, b=c=2.5 cm with air as dielectric
   (b) Derive the expression for the guide wavelength of $TE_{m,n}$ mode in rectangular wave guide. How is it different from cut-off and free space wavelengths.[6+10]

6. (a) Describe with a neat sketch a dissipative attenuator.
   (b) Explain the working principle of dielectric phase shifter, with a neat sketch. How can the phase shift be varied? [8+8]

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. [6+10]

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. [8+8]

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

III B.Tech II Semester Supplementary Examinations,
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is transit time effect? What is the importance of this transit time in microwave tubes? Can we use vacuum tubes at microwave frequencies?
   (b) A reflex Klystron uses an accelerating voltage of 300 V and operates at a frequency of 2 GHz. Power output maxima are found to occur at reflector voltages of -8Volts, -12 Volts and 360 volts. Identify the transit times of the observed modes?. [8+8]

2. (a) A helix traveling wave tube is operated with a beam current of 300 mA, beam voltages of 5 KV and characteristic impedance of 20 Ohm. What length of the helix will be selected to give a output power gain of 50 dB at 10 GHz.
   (b) Explain how the amplification takes place in TWT. Compare its bandwidth with Klystron amplifier.. [10+6]

3. (a) Explain the growth of oscillations in a traveling wave magnetron.
   (b) Compare the features of rising Sun magnetron with cavity magnetron. [8+8]

4. (a) Explain the GUNN effect in semiconductor devices. Discuss how it leads to negative resistance and hence oscillations at Microwave frequency.
   (b) Write short notes on "IMPATT diode". [8+8]

5. (a) A rectangular wave-guide has a cross section of 1.5 cm x 0.8 cm, σ=0, μ= μ_0 and $\in$= 4$\in_0$. The magnetic field component is given as
   $H_x = 2Sin\left(\frac{\pi x}{a}\right)\cos\left(\frac{3\pi y}{b}\right)Sin\left(\pi \times 10^{11}t - \beta\, z\right) A/m$
   Determine
      i. The mode of operation
      ii. The cut off frequency
      iii. The phase constant
      iv. The propagation constant
      v. The wave impedance.
   (b) Write short notes on "Rectangular resonant Cavity". [10+6]

6. (a) What is magic Tee? Describe the properties of magic Tee, giving its S-Matrix.
   (b) Show a wave-guide with cylindrical post and describe its behaviour. How can it be used, when it is inserted half way into the wave-guide? [10+6]

7. (a) What are ferrites? List out their characteristics.

(b) What are scattering parameters? Explain the S matrix of a three port ideal circulator. [8+8]

8. (a) Draw the experimental setup necessary for the measurement of impedance using slotted line and explain.

(b) What are the characteristics of detectors used in microwave measurements? [8+8]

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Code No: RR320404 **Set No. 4**

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) List out the various advantages of using microwave frequencies for various applications.
   (b) With the help of velocity diagram explain principle of two cavity Klystron Amplifier. [6+10]
2. (a) Mention the characteristics and applications of TWT.
   (b) Draw the simplified circuit of helix traveling wave tube and explain how amplification is achieved in this tube.. [8+8]
3. (a) Explain the growth of oscillations in a traveling wave magnetron.
   (b) Compare the features of rising Sun magnetron with cavity magnetron. [8+8]
4. (a) Explain the GUNN effects where by negative resistance and therefore oscillations are present in bulk gallium arsenide? Why GUNN revices are called diodes?
   (b) An IMPATT diode has a drift length of 2 μm.
   determine
      i. The drift time of the carries and
      ii. The operating frequency of the diode. [8+8]
5. (a) A rectangular wave-guide has a cross section of 1.5 cm x 0.8 cm, σ=0, μ= μ_0 and $\in$= 4$\in_0$. The magnetic field component is given as
   $H_x = 2Sin\left(\frac{\pi x}{a}\right)\cos\left(\frac{3\pi y}{b}\right)Sin\left(\pi \times 10^{11}t - \beta\, z\right) A/m$
   Determine
      i. The mode of operation
      ii. The cut off frequency
      iii. The phase constant
      iv. The propagation constant
      v. The wave impedance.
   (b) Write short notes on "Rectangular resonant Cavity". [10+6]
6. (a) Explain
      i. Coupling Probes
      ii. Coupling loops.

(b) What is a phase shifter? Explain its principle of operation with a neat sketch. Give its applications. [8+8]

7. (a) Obtain the S-Matrix of an ideal 3dB directional coupler.
   (b) Write short notes on "Ferrite Devices". [8+8]

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. [8+8]

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