Code No: RR311701 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2005
MICROWAVE ENGINEERING
(Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain how microwave engineering is different from low frequency electronic engineering.
   (b) Derive an expression for the power output and efficiency of a two cavity Klystron? What is the maximum efficiency that can be obtained?. [8+8]

2. (a) Discuss the role of Helix in TWT amplifier with the help of its Brillouin diagram.
   (b) A traveling wave tube operates under the following parameters.Beam Voltage $V_o = 3$ KV, $I_o = 30$ mA, Characteristic impedance of helix $Z_o = 10\Omega$, Circuit length (N) = 50, Frequency f = 10 GHz. Determine:
      i. the gain parameter
      ii. output power gain in decibels.. [8+8]

3. (a) Describe how microwave frequencies are generated in a magnetron tube with neat sketches.
   (b) What is Π mode? What are the various modes that are possible in a magnetron. [8+8]

4. (a) Discuss the principle of "MASER" and its applications.
   (b) Write short notes on "Parametric Amplifier". [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) Draw a neat sketch of magic T-junction. Imagine that a source is connected to arm 'P', and arm 'S' is match terminated. Arms 1 and 2 are terminated in reflection coefficients of 0.2 and 0.3 respectively. What is the VSWR seen by the source?

(b) Draw the H-plane Tee junction and explain its properties. [8+8]

7. Write short notes on

   (a) Properties of S matrix.

   (b) Gyrator and its applications. [8+8]

8. (a) Explain how you measure VSWR of given load for all kinds of loads possible.

   (b) Give the measurement procedure of Q factor of a resonant cavity. [8+8]

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Code No: RR311701 **Set No. 2**

III B.Tech I Semester Regular Examinations, November 2005
MICROWAVE ENGINEERING
(Electronics & Telematics)

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 $\omega^2\ L_K\ C_{gk}\ g_m + j\omega C_{gk}$, 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) What is a slow wave structure? Explain and differentiate between different structures.
   (b) Explain the working principle of TWT amplifier.. [8+8]

3. (a) Draw the sketches of different types of magnetron anodes.
   (b) Explain Hatree conditions. Derive the voltage under this condition for linear magnetron. [6+10]

4. (a) What are the properties of parametric up converter and down converter? What are their applications?
   (b) Explain the principle and working of a GUNN diode oscillator? Give a neat sketch of the oscillator at X-band. [8+8]

5. (a) Derive the expressions for cutoff frequency, phase constant, group velocity, phase velocity and wave impedance in rectangular wave guide, for TE modes.
   (b) An air filled circular waveguide is to be operated at a frequency of 6 GHz and is to have dimensions such that fc=0.8f for the dominant mode.
   Determine
      i. The diameter of the guide
      ii. Guide wave length and
      iii. Phase velocity in the guide [10+6]

6. (a) Sketch a 4 port Hybrid junction. Justify that it is basically a 3 dB directional coupler.
   (b) A 20-mw signal is fed into the series arm of a loss less Magic Tee junction. Calculate the power delivered through each port when other ports are terminated in matched load. [8+8]

7. (a) Explain how a magic Tee can be use for a circulator configuration with neat sketches.

(b) Ten watts is applied to the input of a coupler whose output end is terminated in a matched load. The auxiliary output is found to be 100 milli watts. When 10 watts is applied to the output end of the coupler and the input is terminated in a matched load, the auxiliary output is found to be 10μ watts, find both the coupling and directivity. Define the parameter involved. [8+8]

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: RR311701 **Set No. 3**

III B.Tech I Semester Regular Examinations, November 2005
MICROWAVE ENGINEERING
(Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Compare "Drift space bunching" and "Reflector bunching" with the help of Applegate diagrams.
   (b) A reflex Klystron operates at the peak of n=1 or $^3/_4$ mode. The dc power input is 40mW and ratio of V_1 to V_0 is 0.278.
      i. Determine the efficiency of the Reflex Klystron Oscillator
      ii. Find the total power output in mW.
      iii. If 20% of the power delivered by the electron beam is dissipated in the cavity walls, find the power delivered to the load.. [6+10]

2. (a) Explain the characteristics of slow wave structures used in traveling wave tubes. Why is helix preferred?
   (b) Backward wave oscillator is a voltage controlled oscillator. Justify this statement.. [8+8]

3. (a) Write short notes on "Magnetron Oscillator", and its applications.
   (b) A cylindrical magnetron is operated at 5 GHz with a= 3 cm, b= 5 cm, N=16, V_0 = 20KV, B_0 = 0.05 T calculate hull cut off voltage and cut off magnetic flux density and Hatree voltages. [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) Show that the TEM, TM01 and TM10 modes in a rectangular wave-guide do not exist.
   (b) Discuss the merits and demerits of circular wave guide over rectangular wave guide. [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) Determine the S parameters for a 10dB directional coupler. The directivity is 30 dB. Assume that directional coupler is lossless and the VSWR at each port is 1.0 under matched conditions.
   (b) Explain the Faraday rotation in Ferrites in detail. [8+8]

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: RR311701 **Set No. 4**

III B.Tech I Semester Regular Examinations, November 2005
MICROWAVE ENGINEERING
(Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss in detail about lead inductance and inter electrode capacitance effects of conventional tubes at microwave frequencies.
   (b) What is electronic Admittance? Discuss its significance and the mode patterns of Reflex Klystron Oscillator. [8+8]

2. (a) What are the desirable properties of slow wave structures to be used in TWT amplifiers.
   (b) Draw a neat sketch of traveling wave tube and explain its principle of operation with bunching diagrams.. [8+8]

3. (a) Explain how magnetron is different from Reflex Klystron both being oscillators.
   (b) Explain about Hull cut off voltage and Hull cut off magnetic flux density in a circular 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) Starting with the equation for the propagation constant of a mode in a rectangular wave guide, Derive the expression $\lambda = \frac{\lambda g \lambda c}{\sqrt{\lambda g^2 + \lambda c^2}}$
   Where λ_g is the guide wave length and λ_c is the cutoff wave length
   (b) An air filled rectangular wave guide has dimensions of 0.9" x 0.4" and is supporting TE_{10} mode at a frequency of 9800 MHz. Calculate the wave guide impedance. Calculate the percentage change in this impedance for a 10% increase in the operating frequency. [8+8]

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? What property do they have different from ordinary conductors or insulators?

   (b) Describe any one microwave component which make use of Faraday rotation principle, with neat sketches. [8+8]

8. (a) Explain the method to measure VSWR and reflection co-efficient.

   (b) Describe the measurement of impedance using slotted line and Smith chart. [8+8]

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