ANNA UNIVERSITY :: CHENNAI – 600 025

MODEL QUESTION PAPER

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER - 7

EC432 MICROWAVE ENGINEERING

Time: Three Hours **Maximum : 100 Marks**

Answer All The Questions

PART - A (2 x 10 = 20 Marks)

1. With the help of electronic admittance diagram explain the modes of a reflex klystron oscillator.

2. A two-cavity klystron operates at 10 GHz with I_0 = 3.6 mA, V_0 = 10KV. The drift space length is 2 cms, the output cavity total shunt conductance is G_{sh} = 20 μ mho and the beam coupling coefficient β_2 = 0.92. Find the maximum voltage gain.

3. Explain the use of a PIN device as a single switch and a double switch circuits.

4. Give the comparison between IMPATT, TRAPATT and BARITT diodes considering their performance characteristics and applications.

5. Establish the relation between Z and S matrices of a two-port network.

6. Derive the scattering matrix of a H plane T.

7. Explain the concept of choke flange and how it is realized in microwave joint.

8. Explain the use of magic T in a balanced microwave mixer.

9. Explain the principle of the power meter double bridge circuit for microwave power measurement.

10. A crystal detector generates a signal of 10 m V for an incident microwave power of -25 dBm. What is the detector sensitive in mV/ mW ? Why is the microwave signal amplitude modulated by a 1 KHz square wave before it is applied to a crystal detector?

PART - B (5 x 16 = 80 Marks)

11. Derive the expressions for power output and efficiency of a reflex klystron

oscillator.

A reflex klystron operators at frequency 5 KHz with repeller space L =- 0.5 cm, dc beam voltage V_0 =300V, beam current I_0 = 20 mA, repeller voltage - V_R volt for 1¾ mode. Calculate (i) maximum power output (ii) repeller voltage, (iii) the bandwidth for the range of ΔV_R = 1V, (iv) efficiency.

12.a) Explain with the help of neat diagram the construction and amplification process in TWTA. Draw the rf power output and gain characteristic curves.

A helix TWT operates at 5 GHz under a beam impedance 8KV and beam current 400 mA. The helix impedance is 20 ohm and the interaction length is 25 cm. Find the output power gain in dB.

(OR)

12.b) Draw the schematic diagram of a cylindrical magnetron tube oscillator. If a & b are outer & inner radii of the cathode and anode cylinders respectively, derive the expression for the cut off magnetic field B_c. Give three important application of magnetron with power and frequency specifications.

A cylindrical magnetron with 16 resonators is operated at 1 GHz with a = 3 cm, b= 5 cm, V_0= 20 KV, B_0 = 0.1 Tesla. Find the Hartree voltage.

13.a) Draw the electrical equivalent circuit of a Gunn diode explaining the parameters. Explain with diagram how a Gunn diode oscillator can be designed using rectangular waveguide in X-band. Give typical power output and frequency tuning range achievable. What is the difficulty in obtaining very high power?

The drift velocity of electrons is 3 x10^7 cm/s, through the active region of length 20 x 10-^{4} cm. Calculate the natural frequency of the diode and the critical voltage for GaAs. Critical field for GaAS is 3.2 KV / cm.

(OR)

13.b) Explain how Varactor diode is used as frequency multiplier, State and explain Man1ey Rowe relations with the help of the circuit diagram.

A sinusoidal input signal at frequency f_s and pump signal at frequency f_p are applied across a varactor diode. If the output circuit is a bandpass filter with resistive series load at frequency $f_s + f_p$, calculate the power gain.

14.a) What are the properties of S parameters of a perfectly matched, lossless, reciprocal microwave network?

A matched magic-T is terminated at collinear ports 1&2 and difference port 4 by

impedances of reflection coefficients $\Gamma_1 = 0.5$, $\Gamma_2 = 0.6$ & $\Gamma_4 = 0.8$ respectively. If I-watt power is fed at a sum port 3, calculate the power reflected at port 3 & power transmitted to other three ports.

OR

14.b) Explain with a schematic diagram. The working principle of a four part circulator and how it is achieved. A three port circulator has an insertion loss of dB, isolation 30 dB and VSWR = 1.5. Find the S-matrix.

15.a) Why VSWR> 20 is not measured directly by VSWR meter? Explain the theory of double minimum method of experimentally determining high VSWR of a load by using w/g-slotted line. What are the possible errors in the slotted line method?

OR

15.b) Define antenna test ranges. Explain with a schematic diagram the antenna gain measurement with three-antenna method. How do you predict about the polarization of the signal from the measured output voltage pattern?