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Reg. No. : .....

Name : .....

Eighth Semester B.Tech. Degree Examination, January 2018
(2013 Scheme)
13.805.6 : MICROWAVE DEVICES AND CIRCUITS (T)
(Elective – V)

Time : 3 Hours Max. Marks : 100

Instruction : *Provide Smith Chart to students on their* ***request.***

PART – A

Answer **all** questions :

1. Distinguish between dominant and degenerate modes in Circular Waveguide.

2. Calculate the resonant frequency of a circular resonator of the following dimensions; diameter = 12.5 cm and length = 5 cm for TM_{012} mode.

3. Which type of mode is supported by microstrip line ?

4. List the disadvantages of circular waveguides.

5. Write note on Richard's transformation.

6. List the applications of Magic Tee.

7. An IMPATT diode has a drift length of 2 μm. Determine the operating frequency of IMPATT diode if drift velocity is 10^7 cm/s.

8. List the applications of Varactor Diodes.

9. List the applications of MESFET.

10. A TRAPPAT has the parameters doping concentration $N_A = 2 \times 10^{15}$ cm^{-3}; current density J = 20 kA/cm^2. Calculate the avalanche zone velocity.

(10×2=20 Marks)

P.T.O.

PART – B

Answer **one full** question from **each** Module carrying **20** marks.

Module – 1

11. a) Sketch the field distributions TE_{11} and TM_{02} inside cylindrical waveguide. **6**

    b) Briefly explain the excitation methods in circular Waveguide. **6**

    c) An airfilled waveguide has a radius of 2 cm and is to carry energy at a frequency of 10 GHz. Find all TE and TM modes. **8**

12. a) Design a lowpass filter and implement using microstrip lines. Cutoff frequency 4 GHz; 3rd order $Z_0 = 50\,\Omega$ and 3dB equal ripple characteristics. ($g_1 = 3.3487$, $g_2 = 0.7117$, $g_3 = 3.3487$, $g_4 = 1.000$). **12**

    b) With steps illustrate how frequency and impedance transformation to bandpass, high pass and band stop filters. **8**

Module – 2

13. a) Derive the S-matrix of E plane Tees. **8**

    b) Match a $300\,\Omega$ to $Z_L = 150 + j225\,\Omega$ by means of double stub such that the stubs are $0.1\,\lambda$ apart. Load impedance is $0.2\,\lambda$ from first stub. **12**

14. a) Derive the S matrix of magic Tee. **12**

    b) An isolator has insertion loss of 0.5 dB and isolation 30 dB. Determine the S-matrix of isolator if the isolated ports are matched to the junction. **8**

Module – 3

15. a) Draw the energy band diagram of heterojunction bipolar transistor. **7**

    b) Explain the principle of operation of TRAPPAT diode. **13**

16. a) With diagrams explain how negative resistance is achieved in Read diode. **12**

    b) An IMPATT diode has carrier drift velocity $V_d = 2 \times 10^7$ cm/s, drift length region $L = 6\,\mu m$, max operating voltage $Vo_{max} = 100V$; $Io_{max} = 200$ mA; efficiency $\eta = 15\%$, breakdown voltage $V_{bd} = 90V$. Find max. CW output power in W and resonant frequency in GHz. **8**

Module – 4

17. a) Write note on parametric up and down converter. What is the difference between normal amplifier and parametric amplifier ? **13**

    b) The figure of merit for a diode nonlinear capacitor in parametric upconverter is 8 and the ratio of output frequency over signal frequency is 8. The diode temp. is 300 K. Calculate the max. power gain; noise figure and bandwidth for r = 2. **7**

18. a) A negative resistance parametric amplifier has parameters; fs = 2GHz, fp = 12 GHz, fi = 10 GHz, fd = 5 GHz; Ri = Rg = RTs = RTi = 1kΩ , r = 0.35, rQ = 10, rd = 300 K, C = 0.01pF. Calculate equivalent noise resistance, gain, noise fig and bandwidth. **12**

    b) Write note on performance characteristics, applications and disadvantages of MASERS. **8**