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Question Paper Code : 51256

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Seventh Semester

Electronics and Communication Engineering

080290059 — MICROWAVE ENGINEERING

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define : Reciprocity theorem.

2. State the [S] matrix of a directional coupler.

3. Mention the differences between TWT and Klystron.

4. Define crossed-field tubes.

5. Define: Insertion loss(S_{21}) and Return loss(S_{11}).

6. Mention the significance of slotted line with tunable probe detector.

7. Mention the differences between microwave transistors and transferred electron devices.

8. State the principle of avalanche diode oscillator.

9. Define : Coplanar striplines.

10. Draw the schematic and field (E & H) line diagram of micro strip lines.

PART B — (5 × 16 = 80 marks)

11. (a) Prove that [S] matrix for a reciprocal network is symmetric, and that the [S] matrix for a lossless network is unitary. (16)

Or

(b) (i) A two-port network is known to have the following scattering matrix :

$$[S]=\begin{bmatrix} 0.2<0 & 0.45<-45 \\ 0.45<45 & 0.25<0 \end{bmatrix}$$

Determine if the network is reciprocal, and lossless. If port two is terminated with a matched load, what is the return loss seen at port 1? If port two is terminated with a short circuit, what is the return loss seen at port 1? (8)

(ii) Find the impedance parameters of a section of transmission line with length l, characteristic impedance Z_0, and propagation constant β. (8)

12. (a) (i) Explain the limitations of conventional vacuum triodes, tetrodes and pentodes at frequencies greater than 1 GHz. (8)

(ii) Explain the working principle of two-cavity klystron with a suitable diagram. (8)

Or

(b) (i) Explain the amplification process of helix TWT with a suitable diagram. (8)

(ii) A traveling-wave tube operates under the following parameters : Beam Voltage(Vo) 3KV, Beam Current(Io) 30mA, Characteristic impedance of helix(Zo) 10 Ω, Circuit length(N) 50, Frequency(f) = 10GHz. Determine : Gain parameter C, Output power gain A_p in dB and all four propagation constants. (8)

13. (a) Explain the experimental setup to measure VSWR and Impedance of a slotted line section. (16)

Or

(b) Explain the network analyzer experimental setup to measure the return loss (S_{11}) and insertion loss (S_{21}) of a planar microwave device. (16)

14. (a) (i) A typical GaAs Gunn Diode has the following parameters: Threshold field 2800V /cm, Applied field 3200V/cm, Device length 10 μm, Doping concentration $2 \times 10^{14} cm^{-3}$, Operating frequency 10GHz. Determine electron drift velocity, current density and negative electron mobility. (8)

(ii) Brief about the different modes of operation of Gunn Diode. (8)

Or

(b) (i) An IMPATT diode has the following parameters : Carrier drift velocity 2×10^7cm/s, Drift-region length 6 μm, Maximum operating voltage 100V, Minimum operating current 200mA, Efficiency 15% and Breakdown voltage 90V. Compute the maximum CW output power (Watts) and the resonant frequency (GHz). (8)

(ii) Explain the physical structure and operating principle of TRAPATT diodes. (8)

15. (a) (i) A certain microstrip line has the following parameters : $\varepsilon_r = 5.23$, $h = 7$ mils, $t = 2.8$ mils, $w = 10$ mils. Calculate the characteristic impedance Z_0 of the line. (8)

(ii) Explain the losses in a microstrip lines. (8)

Or

(b) (i) A lossless parallel strip line has a conducting strip width w. The substrate dielectric separating the two conducting strips has a relative dielectric constant ε_{rd} of 6 and a thickness d of 4mm. Calculate required width w of the conducting strip to achieve Z_0 of 50 Ω, strip line inductance, phase velocity of the wave in the parallel strip line. (8)

(ii) A shielded strip line has the following parameters : Dielectric constant of the insulator (ε_r) 2.56, Strip width(w) 25 mils, Strip thickness(t) 14 mils, Strip depth(d) 70 mils. Calculate the K-factor, Fringe capacitance, Characteristic impedance of the line. (8)
