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Question Paper Code : 51222

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Seventh Semester

Electronics and Communication Engineering

EC 1402 A – MICROWAVE ENGINEERING

(Regulation 2008)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why are s-parameters important at high frequencies? Name the properties of s-parameters.
2. Define loss less network and reciprocal network.
3. Draw the H-Plane Tee junction.
4. A directional coupler with 20 dB is used to couple power. If the incident power is 1 mw, what is the coupled power?
5. A reflex klystron is operated at 9 GHz with a dc beam voltage of 600 V for 1 3/4 mode, repeller space length of 1 mm and dc beam current of 10 mA, beam coupling coefficient to be 1. Calculate the repeller voltage.
6. List the application of TWT amplifier.
7. Draw the Gunn diode characteristics.
8. What are the uses of parametric amplifier?
9. A generator feeds a rectangular wave guide (0.9 cm × 0.4 cm) operating in the TE₁₀ mode. When terminated in a short circuit the two successive minima are found to be separated by 2.4 cm, find the operating frequency.
10. Define Q factor of a cavity.

PART B — (5 × 16 = 80 marks)

11. (a) Discuss the properties of scattering matrix. The scattering matrix of a two port device is $\begin{bmatrix} 0.1 & 0.7 \\ 0.7 & 0.1 \end{bmatrix}$. The incident power to port 1 is $P_1 = 50 \text{ mW}$ and $P_2 = 0 \text{ mW}$.

- (i) Calculate a_1 and a_2 (5)
 (ii) Using the scattering matrix, find b_1 and b_2 (5)
 (iii) Determine the reflected power at each of the ports. (6)

Or

- (b) (i) Given $[Y] = \begin{bmatrix} 3.2 & 1 \\ 1 & 3.2 \end{bmatrix}$ find $[S]$. (8)
 (ii) Find the S matrix of a section of a transmission line whose characteristic impedance is Z_0 and propagation constant β . Find Z matrix. (8)

12. (a) Elaborate the following with necessary derivations and sketches:

- (i) Short circuit plunger (5)
 (ii) Directional couplers (6)
 (iii) Tuning screws. (5)

Or

- (b) A lossless T junction power divider has a source impedance of 50Ω . Find the output characteristic impedance so that the input power is divided in a ratio 2 : 1. Compute the reflection co-efficient seen looking into the output ports. (8)

13. (a) (i) Explain the principle of operation of two – cavity klystron with neat sketch. (8)

- (ii) A two cavity klystron has the following parameters.

$V_o = 1000 \text{ V}$, $R_o = 40 \text{ k}\Omega$, $I_o = 25 \text{ mA}$, $f = 3 \text{ GHz}$ Gap spacing in either cavity (d) = 1 mm spacing between two cavities (L) = 4 cm effective shunt impedance (R_{th}) = $30 \text{ k}\Omega$. Calculate input gap voltage to give maximum voltage V_2 , voltage gain and efficiency. (8)

Or

- (b) (i) Draw the diagram of TWT amplifier and explain its working. (8)
 (ii) Draw the diagram of cavity magnetron and discuss phase focusing effect. (8)

14. (a) Give Manley Rowe relations regarding power flow of a non-linear reactance. How this can be used in parametric amplifier? (16)

Or

- (b) Explain the operation of TRAPATT diode. Compare this with IMPATT diode in construction, operation and application. (16)

15. (a) With neat microwave bench block diagram, explain antenna radiation pattern measurement and VSWR measurement. (16)

Or

- (b) Discuss the significance of following microwave measuring instruments with neat diagram.

- (i) Slotted Line Carriage (5)
- (ii) VSWR meter (5)
- (iii) Cavity Resonator. (6)