10EC54

Fifth Semester B.E. Degree Examination, June/July 2015
Microwaves and Radar

Time: 3 hrs.
Max. Marks: 100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Derive:
   i) Voltage and current equations on a transmission line.
   ii) The characteristic impedance of the line.
   iii) Propagation constant.
   iv) Phase velocity.
   v) The relative phase velocity factor. **(12 Marks)**
   b. What is impedance matching? Explain single stub matching and double stub matching.
   (08 Marks)

2 a. Derive $TE_{m,n}$ field equation in rectangular waveguide and define cut off wave number, cutoff frequency, propagation constant, phase velocity, character wave impedance and wave length in the guide. **(10 Marks)**
   b. Explain why TEM mode is not possible in waveguides. **(02 Marks)**
   c. Explain faraday rotation and discuss microwave circulator. **(08 Marks)**

3 a. Discuss the criterion for classifying the modes of operation for Gunn effect diodes. For a transit time domain mode, the domain velocity is equal to the current drift velocity is 10^7 cm/s. Determine the drift length of the diode of a frequency of 8GHz. **(07 Marks)**
   b. Explain how carrier current $I_o(t)$ and external current $I_e(t)$ are generated when a read diode is mounted in a microwave resonant circuit, with the aid of diagrams for structure of read diode, field distribution, applied ac voltage and $I_o(t)$ and $I_e(t)$. **(07 Marks)**
   c. Write equivalent circuit for a parametric amplifier. AN up-converter parametric amplifier has the following parameters:
   i) Figure of merit; $\gamma Q = 8$
   ii) Ratio of output frequency over signal frequency $f_o/f_s = \delta$
   iii) Factor of merit figure; $\gamma = 0.2$
   iv) Diode temperature $T_d = 300° t$
   Calculate: i) The power gain in dB; ii) The noise figure in dB; iii) Bandwidth. **(06 Marks)**

4 a. What is a reciprocal network? For a reciprocal microwave N-port network prove that the admittance and impedance matrices are symmetrical. **(07 Marks)**
   b. State and prove the following properties of S-parameters:
   i) Symmetry property for a reciprocal network.
   ii) Unitary property for a lossless junction. **(08 Marks)**
   c. The impedance matric of a passive network is given by $Z = \begin{bmatrix} 4 & 3 \\ 1 & 2 \end{bmatrix}$, find scattering matrix.
   (05 Marks)

PART – B

5 a. Why are co-axial connectors and adapters used? List six types of co-axial connectors with their frequency ranges. **(05 Marks)**

   b. What are waveguide tees? Explain with the aid of neat diagram, E-plane tree and H-plane tree. **(09 Marks)**

   c. List four applications of Magic-T. Explain Magic-Tee as a microwave mixer. **(06 Marks)**

6 a. Show that, for a micro strip line, the quality factor is $Q_c = 0.636\ h\sqrt{\sigma f_{CH_2}}$. **(07 Marks)**

   b. A gold parallel strip line has the following parameters:
   Relative dielectric constant of polyethylene $\varepsilon_{rd} = 2.25$.
   Strip width; W = 25mm.
   Separation width; d = 5mm
   Calculate:
   i)   Characteristic impedance of the strip line.
   ii)   Strip-line capacitance .
   iii) Strip-line inductance.
   iv)   Phase velocity. **(08 Marks)**

   c. Write a note on coplanar stripline. **(05 Marks)**

7 a. What is radar? With a neat block diagram, explain the operation of radar. **(08 Marks)**

   b. Explain the various forms of radar equation. **(06 Marks)**

   c. Discuss the applications the radar. **(06 Marks)**

8 a. With a neat block diagram, explain CW Doppler radar. **(08 Marks)**

   b. Explain a simple MTI delay line canceller. **(08 Marks)**

   c. Discuss the difference between MTI and Doppler radar. **(04 Marks)**

* * * * *