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**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  $T_d = 300^\circ t$
 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 matrix 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 tee and H-plane tee. (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  $\epsilon_{rd} = 2.25$ .  
 Strip width;  $W = 25\text{mm}$ .  
 Separation width;  $d = 5\text{mm}$   
 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)

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