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06EC54

Fifth Semester B.E. Degree Examination, June 2012
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 an expression for the line impedance Z, at point P, at a distance 'd' from the receiving end interms of Z_L and Z_O. **(08 Marks)**

b. Define and derive expression for reflection coefficient and transmission coefficient for a transmission line. **(06 Marks)**

c. A generator of 1volt, 1kHz supplies power to 100km long line terminated Z_o. The parameters of the line are R = 10.4Ω/km , L = 0.00367H/km , G = 0.8×10^{-6} ℧/km and C = 0.00835×10^{-6} F/km. Calculate Z_o, attenuation constant and phase constant. **(06 Marks)**

2 a. Derive the wave equation for a TM wave and obtain all field components in a rectangular wave guide. **(10 Marks)**

b. Determine the cut off wave length for the dominant mode in a rectangular wave guide of breadth 10cm. A signal of frequency 2.5 GHz is being propagated in the waveguide in the dominant mode. Calculate the guide wave length group velocity and phase velocity. **(04 Marks)**

c. Explain the construction, working and applications of Isolator based on Faraday's rotation. **(06 Marks)**

3 a. Explain the principle of operation of Read diode, with suitable diagrams. **(06 Marks)**

b. Draw the equivalent circuit diagram for parametric amplifier and explain. **(05 Marks)**

c. Derive the expression for the power output and efficiency of IMPATT diode. **(05 Marks)**

d. A gunn oscillator has the following parameters associated with it :
Threshold electric field E_{th} = 250 KV/m ; Applied electric field E = 300 KV/m ;
Device length L = 12μm ; Doping concentration $n_o = n = 1 \times 10^{15}$ cm^3 ;
Operating frequency f = 15 GHz. Compute i) Electron drift velocity ii) Current density iii) Negative electron mobility. **(04 Marks)**

4 a. State and prove the following properties of scattering parameters :
i) Symmetry property ii) Unitary property iii) Zero property
iv) Phase shifting property. **(10 Marks)**

b. Explain the relation between incident and reflected waves interms of scattering parameters for a 2 – port network. Also explain the physical significance of S – parameters. **(06 Marks)**

c. Two transmission lines of characteristic impedance Z_1 and Z_2 are joined at plane PP^1. Explain S parameters interms of impedances. **(04 Marks)**

PART - B

5 a. Explain with a neat sketch, precision type variable attnuator. **(07 Marks)**

b. Explain magic tee and its applications. **(08 Marks)**

c. What are the applications of radar? **(05 Marks)**

6 a. Explain the construction and field pattern for micro strip line. **(08 Marks)**

b. Compare strip line with micro strip line. **(04 Marks)**

c. A strip (shielded strip line) has the following parameters :
Dielectric constant of insulator $t_r = 2.56$; Strip width w = 63.5mm
Strip thickness t = 35mm ; Shield depth d = 180mm. **(08 Marks)**
Compute i) Characteristic impedance ii) K factor iii) Fringe capacitance.

7 a. Derive the radar range equation. Discuss the effects of each parameter on the maximum detection range of the radar. **(10 Marks)**

b. A radar operating at 1.5 GHz uses a peak pulse power of 2.5 MW and has a range of 100nmi for objects, whose radar cross section is $1m^2$. If the minimum receivable power of the receiver is 2×10^{-13}w, what is the smallest diameter of the antenna reflector, assuming it to be a full paraboloid with an aperture efficiency of 0.65. **(10 Marks)**

8 a. Explain the principle and working of MTI radar, with the help of a block diagram. **(10 Marks)**

b. Write brief notes on :
i) Blind speed ii) Delay line canceller. **(10 Marks)**

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