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06EC54

Fifth Semester B.E. Degree Examination, June/July 2011
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. ***Smith chart may be provided.***

PART - A

1 a. Derive an expression for the line impedance of a transmission line, at the sending end, in terms of load impedance (z_ℓ) and characteristics impedance (z_o). **(08 Marks)**

b. Derive the relationship between standing wave ratio (s) and reflection coefficient (r). **(06 Marks)**

c. A load impedance of 73 – j80 ohm is required to be matched to a 50 ohm coaxial line having operating wavelength λ = 30cm, using a short circuited shunt stub. Determine the position and length of the stub. **(06 Marks)**

2 a. Derive electric and magnetic field equations in rectangular waveguides for TM_{mn} mode. **(07 Marks)**

b. With neat diagram, explain construction of a two – hole directional coupler. Derive S – matrix of the coupler. **(07 Marks)**

c. Explain the phenomenon of the gyromagnetic resonance of the ferrite. What is the condition to obtain a differential phase shift of 90^0 for the two directions of wave propagation through the ferrite slab? **(06 Marks)**

3 a. Explain the fundamental concept of the Ridley Watkins – Hilsum (RWH) theory. Derive an expression for the condition for negative resistance in the Gunn diode, with the help of two – vally model. **(08 Marks)**

b. State the two effects by which IMPATT diodes exhibit a differential negative resistance. **(02 Marks)**

c. Draw equivalent circuit of the parametric amplifier. Explain briefly parametric up converter. **(06 Marks)**

d. The drift velocity of electrons is 2×10^7 cm/s, through the active region of length 10×10^{-4} cm. Calculate the natural frequency of the diode and the critical voltage. (Critical field of G_aA_s = 3.2 kV/cm). **(04 Marks)**

4 a. Define the following losses in a microwave network in terms of S – parameters : **(06 Marks)**
i) Insertion loss ii) Transmission loss iii) Reflection loss iv) Return loss.

b. State and derive properties of S – parameters. **(08 Marks)**

c. Derive an expression of the input reflection coefficient of a two port network with mismatched load. **(06 Marks)**

PART - B

5 a. Explain construction and working of a precision rotary type phase shifter, with neat diagram. **(08 Marks)**

b. With neat diagram, explain construction of precision type variable attenuator. **(06 Marks)**

c. A 20 MW signal is fed into one of collinear ports i.e. port – 1 of a lossless H – plane tee. Calculate the power delivered through each port when other ports are terminated in matched load. **(06 Marks)**

6 a. With necessary equations, explain various lossess in microstrip lines. **(08 Marks)**

b. Explain construction of a parallel strip lines, with a neat schematic diagram. State equations of distributed parameters of this line. **(06 Marks)**

c. A shielded strip line has the following parameters :
Dielectric constant of insulator (polystyrene) $\varepsilon_r = 2.56$; Strip width W = 25 mils ;
Strip thickness t = 14 mils ; Shield depth d = 70 mils. Calculate i) The K factor ii) The fringe capacitance iii) The characteristics impedance of the line. **(06 Marks)**

7 a. Define following terms related to RADAR :
i) Range to a RADAR ii) Maximum unambiguous range. **(04 Marks)**

b. Derive an expression for the simple form of the maximum range of the radar. Comment on the radar range equation. **(08 Marks)**

c. A 10GHz RADAR has the following characteristics :
Peak transmitted power = $P_t = 250$ KW ; Power gain of antenna = G = 2500 ;
Minimum detectable peak signal power by the receiver = $S_{min} = 10^{-14}$W.
Radar cross section of the target = $6 = 2m^2$;
Cross – sectional area of the radar antenna = $A_e = 10m^2$.
Find the maximum range (R_{max}) possible. **(03 Marks)**

d. State and briefly explain applications of RADAR. **(05 Marks)**

8 a. With neat block diagram, explain working principle of continuous wave (CW) RADAR. Explain how sign of Doppler frequency is determined. **(07 Marks)**

b. Explain single delay line canceler with neat block diagram. Derive an expression for the frequency response of a single delay line canceler. **(07 Marks)**

c. A 3.25cm pulse Doppler RADAR has a pulse repetition frequency of 4000 PPS. Find
i) the maximum unambiguous range ii) maximum Doppler frequency shift and
iii) maximum radial velocity of the target. **(06 Marks)**

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