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06EC54

Fifth Semester B.E. Degree Examination, Dec.08/Jan.09
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions, choosing at least two questions form each Part.*
2. Missing data may be suitably assumed.
3. Smith chart will be provided.

PART - A

1 a. Derive equations for voltage and current at any point on a transmission line. **(10 Marks)**

b. A transmission line has the following primary constants per km of the line, R = 8Ω, G = 0.1μʊ, L = 3.5 mH and C = 9nF. Calculate Z_o, α, β, V_p and λ at w = 5000 rad/sec. **(06 Marks)**

c. What are standing waves and SWR? **(04 Marks)**

2 a. Explain in brief single stub matching. State the important expressions related to it. **(05 Marks)**

b. A load impedance of $Z_R = (60 - j80)\ \Omega$ is required to be matched to a 50 Ω coaxial line by using a short circuited stub of length L located at a distance 'd' from the load. The wave length of operation is 1 meter. Using smith chart find d and L. **(09 Marks)**

c. Explain the working of four port circulator. **(06 Marks)**

3 a. Explain TM mode of excitation of a rectangular wave guide and derive the equations. **(10 Marks)**

b. Explain the construction, working and application of Isolator based on Faraday rotation. **(06 Marks)**

c. Incident power to a directional coupler is 90W. The directional coupler has coupling factor of 20 dB directivity of 35 dB and insertion loss of 0.5 dB. Find the o/p power at main arm, coupled and Isolated parts. **(04 Marks)**

4 a. Explain the construction and working of PIN diode and IMPATT diode. **(10 Marks)**

b. Explain S – Matrix representation of multipart network. **(04 Marks)**

c. State and explain the properties of S – parameters. **(06 Marks)**

PART - B

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

b. Explain magic tee and it's application. **(06 Marks)**

c. Explain with sketches different coaxial connectors used for microwave applications. **(07 Marks)**

6 a. Explain the Construction and field pattern for microstrip line. **(08 Marks)**

b. What are the different losses taking place in microstrip line? **(06 Marks)**

c. Compare Strip line and Microstrip line. **(06 Marks)**

7 a. With the help of a Block diagram, explain the operation of a Radar system. **(08 Marks)**

b. What are the applications of Radars? **(04 Marks)**

c. Derive Radar range and equation. **(08 Marks)**

8 a. Explain the principle and working of MTI radar with the help of a Block diagram. **(08 Marks)**

b. A radar system operates at 6GHz, 3MW power out put. If the antenna diameter is 5m and the received band width is 1.5 MHz and has a 12 dB noise figure, what is the maximum detection range for $1m^2$ target? **(06 Marks)**

c. Write brief notes on :
i) Blind speeds. ii) Delay line cancellers. **(06 Marks)**

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Fifth Semester B.E. Degree Examination, Dec.09/Jan.10
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Missing data may be suitably assumed.
3. Smith chart may be provided.

PART – A

1 a. Derive the equation for the following at microwave frequency.
   i) Propagation constant
   ii) Attenuation constant
   iii) Phase constant
   iv) Characteristic impedance
   v) Phase velocity. **(12 Marks)**

b. Derive the relationship between SWR and reflection co-efficient. **(03 Marks)**

c. The characteristic impedance of the line is 50 Ω and SWR ρ = 2 when the line is loaded. When the line is shorted, the minima shifts 0.15 λ towards load. Determine the load impedance. Use Smith chart. **(05 Marks)**

2 a. Give the comparison between waveguide and co-axial cable. **(06 Marks)**

b. An air filled rectangular waveguide of inside dimension a = 7 cms and b = 3.5 cm operates in the dominant TE_{10} mode.
   i) Find the cut-off frequency.
   ii) Determine phase velocity of the wave in the guide at a frequency of 3.5 GHz.
   iii) Determine the guide wavelength at the same frequency. **(06 Marks)**

c. How to realize the four-port circulator with directional couplers and phase shifter? Explain. **(08 Marks)**

3 a. Explain with relevant figures the fundamental concept of RWH theory. **(05 Marks)**

b. A typical h-type GaAS Gunndiode has the following parameters:
   Threshold field = E_{th} = 2800 v/cm
   Applied field = E = 3200 v/cm
   Device length = L = 10 μm
   Doping concentration = $n_0 = 2 \times 10^{14}$ cm^{-3}
   Operating frequency = f = 10 GHz.
   i) Compute electron drift velocity
   ii) Calculate the current density
   iii) Estimate the negative electron mobility. **(04 Marks)**

c. Explain the principle of operation of read diode with suitable diagrams. **(06 Marks)**

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

4 a. Explain the relation between incident and reflected waves in terms of scattering parameters for a two port network. Also explain physical significance of s-parameters. **(08 Marks)**

b. Which properties are common in S, Z and Y matrices? **(03 Marks)**

c. Two transmission lines of characteristic impedances Z_1 and Z_2 are joined at plane PP'. Express s – parameters in terms of impedances. **(09 Marks)**

PART – B

5 a. Explain with a neat sketch a precision rotary phase shifter. (06 Marks

b. A 20 mw signal is fed into one of collinear port 1 of a lossless H-plane T-junction. Calculat the power delivered through each port when other ports are terminated in matched load. (06 Marks

c. With a neat sketch explain the different types of strip lines. (08 Marks

6 a. Briefly explain the characteristics of micro strip line. (04 Marks

b. A lossless parallel strip line has a conducting strip width W. The substrate dielectri separating the two conducting strips has a relative dielectric constant $\in rd$ of 6 and thickness d of 4 mm. Evaluate w, c and u_p (in usual notations). (08 Marks

c. Define the following related to radar system:
   i) Pulse repetition frequency
   ii) Rest time
   iii) Duty cycle
   iv) Maximum unambiguous range. (08 Marks

7 a. A radar operating at 3 GHz is radiating power of 200 kw. Calculate the power of th reflected signal at the radar with a 20 m^2 target at 5.556 km. Given $A_e = 9m^2$. Also deriv the necessary formula. (12 Marks

b. Draw the block diagram of a MTI radar that uses a power amplifier as the transmitte Explain the function of each block. (08 Marks

8 Briefly explain the following with reference to radar.

a. Blind speed. (04 Marks

b. MTI improvement factor. (04 Marks

c. 3-pulse cancellers. (06 Marks

d. Recursive filters. (06 Marks

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Fifth Semester B.E. Degree Examination, May/June 2010
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Derive an expression for reflection coefficient and transmission coefficient in the transmission line. **(08 Marks)**

b. What are the applications of Smith chart? Explain briefly. **(06 Marks)**

c. A transmission line having a length of 25 KM is terminated in its characteristic impedance. At a specified frequency, the voltage at a distance of 1 KM from the line is 10% below that of the sending end voltage. Compute the value of the load-end voltage, if the sending end voltage is 40 V. **(06 Marks)**

2 a. With a schematic diagram, explain the directional coupler. Derive an expression and give scattering matrix representation of the directional coupler. **(08 Marks)**

b. With a neat diagram, explain the operation of ferrite rotation isolator. **(06 Marks)**

c. A rectangular – waveguide cavity filled with a dielectric of constant $\epsilon_r = 4$ has a breadth of 4 cm and height of 2 cm. Find the length of the cavity to procedure resonance at 4 GHz. Assume $TE_{|0|}$ mode. **(06 Marks)**

3 a. Explain the principles of operation of the Gunn diode with formation of Gunn domain. And also briefly, explain the modes of operation of the Gunn diode with Gunn-oscillation modes. **(08 Marks)**

b. Explain the operation of the Schottky – barrier diode with its structure. Also explain the fabrication technique with sputtering of aluminium on silicon wafers. Draw the characteristics of Schotty – barrier diode and write its symbol. **(06 Marks)**

c. An Impatt diode operates at 150 V delivering 1A of current at 8% efficiency. Calculate the output power and duty cycle, if the device is operated in pulsed mode at 20 GHz with a pulse width of 0.5 ps. **(06 Marks)**

4 a. What are the different properties of Scattering parameters? Explain briefly. **(08 Marks)**

b. With necessary conditions write the Scattering matrix representation of multiport network generally. **(07 Marks)**

c. Express S – parameters in terms of impedance when two transmission lines are joined with characteristic impedances Z_1 and Z_2. **(05 Marks)**

PART – B

5 a. Explain the salient features of co-axial connectors and adaptors, with diagrams. **(06 Marks)**

b. Explain the characteristics of magic tee passive device, with a schematic diagram. Also obtain the S matrix representation of the magic-tee. **(08 Marks)**

c. With neat diagram of a microwave attenuator, explain the operation of the same. **(06 Marks)**

6 a. Explain the operation of microstriplines with its structure and Quasi TEM mode field distribution. **(07 Marks)**

b. With neat diagram, explain the operation of parallel strip line. And also write the expressions for distributed parameters of parallel strip line, characteristic impedance and attenuation of the same. **(07 Marks)**

c. A certain shielded stripline has W = 63.5 mm, t = 35 mm and d = 180 mm. It has a permittivity of 2.56. Compute its characteristic impedance, K factor and fringe capacitance. **(06 Marks)**

7 a. Derive an expression for the basic form of radar – range equation and hence explain the factors influencing the maximum range of radar. **(08 Marks)**

b. Calculate the maximum range of radar which operates at a frequency of 10 GHz, peak pulse power of 600 kW, if the antenna effective area is $5m^2$ and the area of target is 20 m^2. Minimum receivable power is 10^{-13} watt. **(06 Marks)**

c. What are the applications of radar? Explain each application briefly. **(06 Marks)**

8 a. With block diagram approach, explain the operation of the moving – target indicator (MSI) radar. **(07 Marks)**

b. Explain the basic principles of continuous – wave Doppler radar with block-diagram approach. Also mention the advantages and disadvantages of CW Doppler radar. What are the applications of CW Doppler radar? **(07 Marks)**

c. A moving target indicator radar uses a PRF (pulse repitation frequency) of 1000 Hz at 4 GHz. Compute the lowest blind speed of the radar. Also calculate the second and third lowest blind speeds of the radar. **(06 Marks)**

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