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10EC54

Fifth Semester B.E. Degree Examination, June/July 2013

Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of Smith chart is permitted.***

PART – A

1 a. Staring from the fundamentals, derive the expression for the voltage and current at any point on the transmission line. **(10 Marks)**

b. An open wire line has R = 10 Ω's/km, L = 0.0037 henry/km, C = 0.0083 μf/km, G = 0.4 μ℧/km. Determine Z_o, α, β, γ, V_p if w = 1000 radians/sec. **(05 Marks)**

c. Define the following:
i) Reflection coefficient ii) Transmission coefficient.
Also, derive the relationship between them? **(05 Marks)**

2 a. With a neat diagram, explain the working of a two-hole directional coupler. Also derive the Scattering matrix of the same. **(10 Marks)**

b. A load impedance of 26-j16Ω's is required to be connected to a line of characteristic impedance 100 Ω's by using a short circuited stub of length, ℓ located at a distance, d from the load. The wavelength of operation is 1 m. Using Smith chart find d and ℓ. Write the procedural steps. **(10 Marks)**

3 a. With a neat diagram, explain the construction, working and application of an Isolator based on faraday rotation. **(10 Marks)**

b. An IMPATT diode has the following parameters:
Carrier drift velocity, $V_d = 2 \times 10^7$ cm/s
Drift region length, L = 6 μm
Maximum operating voltage = 100 V
Maximum operating current = 200 mA
Efficiency, η = 15%
Breakdown voltage, V_{bd} = 90 V
Compute: i) Maximum output power, ii) Resonant frequency. **(05 Marks)**

c. A typical Silicon BARRIT diode has the following parameters:
Relative dielectric constant, $\epsilon_r = 12.5$
Donor concentration, $N = 3.2 \times 10^{22}/m^3$, $\epsilon_o = 8.854 \times 10^{-12}$
Drift length, L = 8 μm
Calculate: i) Critical voltage, ii) Breakdown voltage, iii) Breakdown electric field. **(05 Marks)**

4 a. Explain with a neat diagram the construction and working of PIN diode and Schottky barrier diode. **(10 Marks)**

b. Explain S-matrix representation of multi-port network. **(04 Marks)**

c. State and explain the properties of S-matrix. **(06 Marks)**

PART – B

5 a. With a neat diagram, explain the working of a precision type variable attenuator. **(06 Marks)**

b. With a neat diagram, explain the working of a E-plane Tee junction. Also derive its Scattering matrix. **(10 Marks)**

c. A three port circulator has an insertion loss of 2 dB, isolation loss of 25 dB and VSWR = 2.0. Find the S-matrix. **(04 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? Explain. **(06 Marks)**

c. Compare strip line and microstrip line. **(06 Marks)**

7 a. Starting from the power density of an isotropic antenna, derive an expression for the Radar-range equation. Also, explain the factors influencing the maximum range of the radar. **(10 Marks)**

b. Define the following related to radar system:
   i) Maximum unambiguous range
   ii) Doppler effect
   iii) Blind speed
   iv) Duty cycle **(04 Marks)**

c. A 10 GHz Radar has the following characteristics:
   Peak transmitter power = 250 KW
   p.r.f. = 1500 PPS
   Pulse width = 0.8 μsec
   Power gain of the antenna = 2500
   Minimum detectable peak signal power by receiver = 10^{-14} watts
   Effective area of the antenna = 10 m^2.
   If this radar were to be used to detect a target of 2m^2 equivalent cross section, find the following:
   i) Maximum possible range
   ii) Unambiguous range
   iii) Duty cycle
   iv) Average power **(06 Marks)**

8 a. With a neat block diagram, explain the principle and working of an MTI Radar. **(08 Marks)**

b. Am MTI Radar used PRF of 1000 PPS at 4 GHz. Compute the lowest blind speed of the Radar. Also calculate the second and third lowest blind speed of the radar. **(04 Marks)**

c. Write brief note on any TWO:
   i) Delay line canceller
   ii) CW Doppler Radar
   iii) Pulsed Radar system
   iv) Various applications of Radar. **(08 Marks)**

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