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A 1228

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Sixth Semester

Electronics and Communication Engineering

EC 342 — EM WAVES AND WAVE GUIDES

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by dissipation factor?
2. Write down the constitutive relations.
3. Draw the electric flux lines in strip line and micro strip line.
4. Bring out the significance of propagation constant.
5. Justify the impossibility of existence of TEM waves inside waveguide.
6. What are the possible methods for feeding rectangular guides for TE_{10} , TE_{11} , TE_{20} and TM_{11} .
7. What is the distinctive characteristics of the attenuation constant of TE_{0n} modes in a circular waveguide.
8. List some general properties of Bessel functions of the first kind.
9. What field components exist in a circular cylindrical cavity operating in TM_{010} mode?
10. Specify the modes of lowest orders in rectangular cavity resonators.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Define polarization. Explain with neat phasor diagrams how the field vectors vary with time for linear, elliptic and circular polarization. (8)
- (ii) What is meant by homogeneous, isotropic medium? Derive the expression for wave equation (in free space) (8)

Or

- (b) (i) Derive the ratio of reflected to incident electric field strength and the ratio of transmitted to incident electric field strength for both perpendicular and horizontal polarizations by matching both electric and magnetic fields at the boundary. Define Brewster angle in the course of your derivation. (8)
- (ii) Describe and derive necessary mathematical relations to explain the phenomena of reflection at the surface of a Conducting medium. (8)
12. (a) Starting from Maxwells equations applying appropriate boundary condition, obtain the expressions for the field components for the wave between parallel planes. (16)

Or

- (b) (i) List the properties of TEM Waves (4)
- (ii) Derive expression for attenuation factor of TE and TM waves and interpret them. Sketch the variation of attenuation with frequency for different modes propagating between parallel planes (12)
13. (a) Solve Maxwells equations with appropriate boundary conditions to determine the electromagnetic field configuration within a waveguide for Transverse magnetic Waves. Hence derive expressions for propagation constant, Phase velocity and wavelength in the guide. (16)

Or

- (b) (i) A rectangular waveguide has cross sectional dimension $a = 7\text{cm}$, $b = 4\text{cm}$. Determine all the modes which will propagate at a frequency of 5 GHz. (8)
- (ii) Obtain the expression for wave impedance for waves between parallel conducting planes. (8)

14. (a) (i) Arrive at the solution of wave equation to obtain the field components of TM waves in circular waveguides (10)
- (ii) Show that TE_{11} mode is the dominant mode in a Circular waveguide. Sketch the electric and magnetic field lines for the TE_{11} mode. (6)

Or

- (b) (i) A 8 GHz signal is to be transmitted inside a hollow circular conducting pipe. Determine the inside diameter of the pipe such that its lowest cutoff frequency is 10% below this signal frequency. If the pipe is to operate at 12 GHz what waveguide modes can propagate in the pipe. (8)
- (ii) Sketch the $\omega - \beta$ diagrams for TE_{11} and TM_{01} modes in a hollow circular waveguide of radius 'a'. Discuss how the diagrams will be affected.
- (1) if a is doubled
- (2) if the waveguide is filled with a nonmagnetic medium having a dielectric constant ϵ_r . (8)
15. (a) (i) Explain the excitation of cavity modes by a coaxial line in a rectangular cavity resonator. (6)
- (ii) Define quality factor of a cavity resonator. Find the Q of an $a \times b \times d$ cavity for TM_{101} mode. (10)

Or

- (b) Write short notes on :
- (i) Unloaded Q. (4)
- (ii) Wave impedance. (4)
- (iii) Surface impedance. (4)
- (iv) Dielectric Slab waveguides. (4)