B 317

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Sixth Semester

Electronics and Communication Engineering

EC 342 — ELECTROMAGNETIC WAVES AND WAVE GUIDES

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define uniform plane wave.

2. Specify the significance of surface impedance.

3. What is the significance of a purely reactive wave impedance?

4. Define phase velocity and group velocity.

5. State the boundary conditions to be satisfied by E_z for TM waves in a rectangular waveguide.

6. What is the cutoff wavelength of the TE_{10} mode in a rectangular waveguide?

7. Which mode is the dominant mode in a rectangular waveguide?

8. What is the distinctive characteristic of the attenuation constant of TE_{on} modes in a circular waveguide?

9. Define the quality factor Q of a resonator.

10. Will the Q of a circular cylindrical cavity resonator be higher or lower by increasing its length? Give physical reasoning.

PART B — (5 × 16 = 80 marks)

11. Show that TE_{11} mode is the dominant mode in a circular waveguide. Sketch the field lines for TE_{11} mode in a transverse plane of a circular waveguide.

12. (a) Starting from Maxwell's equation derive the wave equations for a conducting medium, and obtain the general solution of it.

Or

(b) Explain with suitable mathematical expressions the reflection by a prefect dielectric and a perfect insulator when a wave is incident normally on it.

13. (a) Show that for TM_{mn} mode of a rectangular waveguide the cut off wavelength λ_c is $(\lambda_c)_{mn} = \dfrac{2}{\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}}$ *meters*.

where a and b are the width and height of the cross section of the waveguide.

Or

(b) Establish that the wave impedance of propagating TE modes in a waveguide with a lossless dielectric in purely resistive and is always larger than the intrinsic impedance of the dielectric medium.

14. (a) Derive the formula for the attenuation constant due to conductor losses in an a × b rectangular waveguide for the TM_{11} mode. Determine the value of $\left(\dfrac{f}{fc}\right)$ at which this attenuation constant is a minimum.

Or

(b) (i) Prove that TEM wave does not exist in hollow waveguides. (6)

(ii) Describe the excitation methods for different TE and TM waves. (10)

15. (a) A copper walled rectangular cavity resonator is structured by 3 × 1 × 4 cm and operates at the dominant modes of TE and TM. Find its resonant frequency and quality factor. The conductivity of copper is 5.8×10^7 mho/m . There is air inside the cavity.

Or

(b) Derive the expression for the resonant frequency of TM_{mnp} modes and show that this frequency increases as the order of a mode becomes higher.

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