

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 2489****Roll No.**

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**B. Tech.**

(SEM. VI) THEORY EXAMINATION 2011-12

**MICROWAVE ENGINEERING***Time : 3 Hours**Total Marks : 100*

**Note :** Attempt *all* questions. All questions carry equal marks.

1. Attempt any *four* parts of the following : **(5×4=20)**
  - (a) Show that TEM mode cannot exist in the hollow waveguide.
  - (b) Define dominant mode, degenerate mode, group velocity and phase velocity in the context of waveguide.
  - (c) Derive the field equations for TE mode in rectangular waveguide.
  - (d) A  $TE_{11}$  mode is propagating through a circular waveguide. The radius of the guide is 5 cm and the guide contains an air dielectric ( $X'_{np} = 1.841$ ), find  $f_c$ ,  $\lambda_g$  and  $z_g$  for an operating frequency of 3.0 GHz.
  - (e) An air filled waveguide with a cross section  $2 \times 1$  cm transports energy in the  $TE_{10}$  mode at a rate of 0.5 hp. The impressed frequency is 30 GHz. What is the peak value of electric field occurring in the guide ?
  - (f) Write short note on Microstrip Transmission Line.

2. Attempt any **four** parts of the following : **(5×4=20)**
- Show that the diagonal elements of the s-matrix of a Tee-junction are not all zeros.
  - Incident power for a 30 dB coupler is 560 MW. Calculate the power in the main arm and in auxiliary arm.
  - A circular cavity resonator having length 8 cm and radius 2 cm is operating in the dominant mode  $TE_{111}$ , ( $X'_{np} = 1.841$ ). Calculate resonant frequency.
  - Derive the s-matrix for a two-hole directional coupler.
  - Explain, how isolator is used to isolate one component from reflection of other components in the transmission line ?
  - Describe the properties of multiport microwave circulator.
3. Attempt any **two** parts of the following : **(10×2=20)**
- What are the limitations of conventional active devices at microwave frequency ?
  - A reflex klystron operates under the following conditions :  $V_o = 600$  V,  $e/m = 1.759 \times 10^{11}$ ,  $f_r = 9$  GHz,  $L = 1$  mm,  $R_{sh} = 15$  k $\Omega$ . The tube is oscillating at  $f_r$  at the peak of the  $\eta = 2$ . Find  $V_r$ , the direct current necessary to give a microwave gap voltage of 200 V and efficiency under this condition ?
  - Explain principle of operation of Backward wave oscillator.
4. Attempt any **two** parts of the following : **(10×2=20)**
- Discuss the Gunn effect and two valley model in detail.
  - With the help of suitable diagram, explain principle of operation of TRAPATT diodes.
  - Discuss the microwave characteristics of tunnel diode.

5. Attempt any **two** parts of the following : **(10×2=20)**
- Calculate the VSWR of a transmission system operating at 10 GHz. Assume  $TE_{10}$  wave transmission inside a rectangular waveguide of dimension  $a = 4$  cm,  $b = 2.5$  cm. The distance between twice minimum power point is 1 mm on a slotted line.
  - Write short note on measurement of insertion loss and attenuation loss.
  - Explain how antenna characteristics are measured ?