

(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)
- Show that TEM mode cannot exist in the hollow waveguide.
 - Define dominant mode, degenerate mode, group velocity and phase velocity in the context of waveguide.
 - Derive the field equations for TE mode in rectangular waveguide.
 - 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 , λ_g and z_g for an operating frequency of 3.0 GHz.
 - An air filled waveguide with a cross section 2×1 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 ?
 - Write short note on Microstrip Transmission Line.

2. Attempt any *four* parts of the following : (5×4=20)

- (a) Show that the diagonal elements of the s-matrix of a Tee-junction are not all zeros.
- (b) Incident power for a 30 dB coupler is 560 MW. Calculate the power in the main arm and in auxiliary arm.
- (c) 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.
- (d) Derive the s-matrix for a two-hole directional coupler.
- (e) Explain, how isolator is used to isolate one component from reflection of other components in the transmission line ?
- (f) Describe the properties of multipoint microwave circulator.

3. Attempt any *two* parts of the following : (10×2=20)

- (a) What are the limitations of conventional active devices at microwave frequency ?
- (b) 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 Ω . 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 ?
- (c) Explain principle of operation of Backward wave oscillator.

4. Attempt any *two* parts of the following : (10×2=20)

- (a) Discuss the Gunn effect and two valley model in detail.
- (b) With the help of suitable diagram, explain principle of operation of TRAPATT diodes.
- (c) Discuss the microwave characteristics of tunnel diode.

5. Attempt any *two* parts of the following : (10×2=20)

- (a) 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.
- (b) Write short note on measurement of insertion loss and attenuation loss.
- (c) Explain how antenna characteristics are measured ?