

Printed Pages—4

EC—601

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

**PAPER ID : 3038**

Roll No.

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**B.Tech.**

SIXTH SEMESTER EXAMINATION, 2005-2006

**MICROWAVE ENGINEERING**

Time : 3 Hours

Total Marks : 100

**Note :** (i) Attempt **ALL** questions.

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data wherever not provided.

(iv) Be precise in your answer.

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

(a) Why TEM waves does not exist in Rectangular waveguide ? Which is the dominant mode of propagation in Rectangular waveguide and why ?

(b) A rectangular waveguide is designed to operate in  $TE_{10}$  mode at a frequency of 10 GHz. It is desired that frequency of operation to be at least 15 % above cut-off frequency of the propagating mode and 20 % below cut-off frequency of next higher mode. Determine the dimension of the wave.

- (c) Prove that  $\frac{1}{\lambda_g^2} + \frac{1}{\lambda_c^2} = \frac{1}{\lambda_o^2}$  where  $\lambda_g$ ,  $\lambda_c$  and  $\lambda_o$  are guided wavelength, cut-off wavelength and free space wavelength.
- (d) How  $TE_{10}$  and  $TM_{11}$  mode can be excited in rectangular waveguide ?
- (e) Derive the various field component present in  $TE_{11}$  mode in cylindrical waveguide.
- (f) What are the salient features of  $TE_{11}$  and  $TM_{01}$  mode in cylindrical waveguide.
2. Attempt *any four* parts of the following : (5×4=20)
- (a) How any rectangular waveguide changes into Resonator ? How the resonant frequency and Q of a cubical of length 10 cm change if its air is replaced by a lossy dielectric of relative permittivity of 2.25 ?
- (b) Derive the various field component present in cylindrical cavity for  $TE_{101}$  mode of propagation.
- (c) Compare Hybrid Tee with Hybrid ring. Give two applications of Hybrid Tee and draw its electrical equivalent ckt.
- (d) Explain the working and application of any two types of wave guide discontinuity.
- (e) Discuss various types of wave guide Attenuators. Specify the special features of cut-off Attenuators.
- (f) Explain the working of four port circulator. Using the S-matrix of 3-port circulator calculate its various parameters if insertion loss = 1.5 dB, Isolation = 35 dB and VSWR = 1.3.

3. Attempt *any two* parts of the following : (10x2=20)

- (a) List the microwave components used to measure frequency, wave length and VSWR. Draw the Block diagram and explain the working of each component.
- (b) What are various methods to Measure Microwave power explain one low power measurement and one High power measurement method with relevant diagram.
- (c) What is Reflecto meter ? How it is used to measure the Reflection coefficient and VSWR of any unknown load. Explain the working of absorption type of wavemeter.

4. Attempt *any two* parts of the following : (10x2=20)

- (a) What are Re-entrant cavities ? Explain with the support of mathematical equations about Bunching process and find out the Beam current at the catcher cavity. A two cavity klystron operates at 10 GHz with  $I_o = 3.6$  mA,  $V_o = 10$  kV. The drift space length is 2 cms and the output cavity total shunt conductance  $G_{sh} = 20 \mu U$  with beam coupling coeff  $\beta_2 = 0.92$ . Find the maximum voltage and power gain.
- (b) Compare TWT with multicavity Klystron and Magnetron. Why slow wave structure is used in TWT ? A travelling wave tube is operated at 10.4 GHz with a beam voltage and current of 3kV and 35 mA. respectively. If the slow wave structure is having characteristic impedance  $Z_o$  of  $12 \Omega$  the electronic circuit length  $N(\frac{1}{\lambda_o}) = 50$ , find out
  - (i) Gain parameter T,
  - (ii) The output power Gain  $A_p$  in decibels.

- (c) Explain the working of cavity magnetron and find out its hull cut-off magnetic field.

5. Attempt *any two* parts of the following : (10x2=20)

- (a) Describe the operating principle and working of Tunnel diode and PIN diode.
- (b) What is transferred electron effect ? In which type of material it is present ? How the Domain formation is taking place in Gunn devices and what are its various modes of operation ?
- (c) How Avalanche effect is utilized to generate microwave signals. Explain the operation of IMPATT and TRAPATT.

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