EC

Printed Pages – 4 **EC – 601**

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

PAPER ID : 3038 **Roll No.**

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.

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1. Attempt *any four* parts of the following : **(5x4=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 λ_g, λ_c and λ_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 : **(5x4=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 $G_{sh} = 20\ \mu\ \mho$ 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 Ω the electronic circuit length $N(1/\lambda_o) = 50$, 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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