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

PAPER ID : 3038 Roll No. | | | | | | | | | | |

B.Tech.

SIXTH SEMESTER EXAMINATION, 2004-2005

MICROWAVE ENGINEERING

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt ALL questions.*

(ii) Assume suitable data, if necessary.

1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Describe the method of designating the mode of transmission in a rectangular waveguide. **(5)**

(b) The dimensions of a rectangular guide are 2.5cm × 1cm. The frequency is 8.6 GHz, find :

(i) Group velocity

(ii) Phase velocity

Assume TE_{10} mode of propagation. **(2x2.5)**

(c) Why is TM_{01} mode of circular waveguide preferred to TE_{01} mode for use in rotary joints ? What is peculiar about the TE_{01} mode in circular guide ? **(2x2.5)**

(d) What is the maximum power (at atmospheric pressure) that can be transmitted by rectangular guide 2cm × 1cm at 9 GHz. **(5)**

(e) Discuss the factors that determine the amount of attenuation in a waveguide. (5)

(f) Draw the cross-sections of strip line and microstrip line alongwith their primary mode patterns. What do you mean by quasi-TEM mode of propagation in a microstrip line ? (3+2)

2. Attempt *any four* parts of the following : (5x4=20)

(a) What is a precision rotary attenuator ? Show that attenuation produced by rotary attenuator is given in decibels by

$A = -40 \log \sin \theta$

Where θ is the angle centre resistive card makes with the direction of the electric field in circular guide. (1+4)

(b) Define coupling factor and directivity of a directional coupler. Justify the following statement. Directivity of a two-hole directional coupler is a sensitive function of frequency. (2+3)

(c) Below what power level can one expect the crystal detector output to follow square the 'square law' ? Define tangential sensitivity of a crystal detector and describe using a block diagram, how to measure it. (1+4)

(d) Illustrate any two methods of coupling energy into a cavity. (5)

(e) What is an isolator ? Explain the principle of operation of resonance isolator. How can you improve the reverse-to-forward attenuation ratio of this isolator ? (1+3+1)

(f) Define quality factor of a cavity. Draw a schematic of cylindrical waveguide tunable wave meter and explain how it measures the frequency of an input signal. (1+4)

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

(a) Why is a 'high quality' square wave necessary when it is used to modulate a reflex klystron signal source for microwave measurements ? Describe a slotted line method to measure values of VSWR above ten with greater accuracy. (3+7)

(b) Distinguish between attenuation and insertion loss. Giving the block schematic of an experimental set-up describe a method to measure insertion reflection loss of a circuit element by standing wave measurements. (3+7)

(c) The p.r.f. of a radar transmitter is 1000 per second. The average power measured by a calorimeter method is 1kW. The pulse width is 1 μ sec. What is peak power level ? Illustrate a method of average power measurement of the transmitter. (4+6)

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

(a) Giving constructional details explain the mechanism of operation of a three cavity klystron amplifier. Specify efficiency, power gain and bandwidth of a typical three-cavity klystron amplifier. (7+3)

(b) With the aid of a schematic diagram, describe the travelling wave tube amplifier. Discuss in a qualitative way the consequences of locating the attenuator in a TWT (i) very close to the output end of the tube and (ii) very close to the gun end of the tube. (5+2.5+2.5)

(c) What are π-mode oscillations ? Explain how oscillations are sustained in the cavity magnetron, with suitable sketches, assuming that π-mode oscillations already exist. (3+7)

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

(a) Draw the band diagram of Ga As and explain the Gunn effect, whereby negative resistance and therefore oscillations are obtainable under certain conditions from bulk gallium arsenide. (10)

(b) Draw the schematic diagram of an IMPATT diode and fully explain the two effects that combine to produce a 180° phase difference between the applied voltage and the resulting current pulse. Give one biggest disadvantage of IMPATT diode oscillator. (8+2)

(c) Describe the basic operating mechanism of TRAPATT diode using a suitable sketch. Why is drift through this diode much slower than through a comparable IMPATT diode ? (7+3)

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