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

PAPER ID : 2489   Roll No. ☐☐☐☐☐☐☐☐☐

B.Tech.

(SEMESTER VI) THEORY EXAMINATION, 2012-13

MICROWAVE ENGINEERING

Time : 3 Hours]   *[Total Marks : 100*

SECTION – A

1. Attempt **all** parts of this question : $10 \times 2 = 20$

    (a) What are microwaves ? Write their frequency range ? How are they different from RF wave ?

    (b) What are degenerate modes ?

    (c) Explain the wave velocities in the context of propagation in waveguides.

    (d) Draw a block diagram to measure scattering parameters.

    (e) State the Pointing theorem. What is the significance of the theorem ?

    (f) Explain why H, Y and Z parameters of a two Port network cannot be measured at microwave frequency ?

    (g) Explain power frequency limitations of a microwave power transistor.

    (h) What are the likely errors that can occur while carrying out standing wave measurement ?

    (i) In multi-cavity Klystron, additional cavities are inserted between the buncher and catcher cavities. Explain its purpose.

    (j) Define Attenuation and Insertion loss.

SECTION – B

2. Attempt any **three** parts of this question : $3 \times 10 = 30$

(a) (i) An air filled rectangular wave guide of inside dimension 7×3.5 cm operates in dominant TE_{10} mode. Find :

(1) Cut off frequency

(2) Determine the phase velocity of the wave in the guide at frequency of 3.5 GHz.

(3) Determine the guided wavelength at the same frequency.

(ii) What is circulator ? Describe construction and working of a Four port Faraday rotation circulator.

(b) Explain the construction and working of directional Coupler. Derive expression for coupling factor and directivity. Compare single hole and double hole directional coupler.

(c) A rectangular cavity resonates in the TM_{111} mode at 5 GHz. Given a $= 8.0$ cm and b $= 6.0$ cm, calculate the resonant frequencies for TE_{101}, TE_{102} and TE_{111} modes. Assume cavity is air filled.

(d) What is a Micro strip line ? How does its characteristic impedance change with change in width to height ratio ? Give a reason for using lower dielectric constant substrate in place of alumina at higher microwave frequencies.

(e) Define the following term and their physical significance with reference to transmission line :

(i) Characteristic impedance

(ii) Insertion loss

(iii) Reflection loss

(iv) VSWR

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SECTION – C

Attempt **all** questions : $5 \times 10 = 50$

3.   Describe the operating principle and characteristics of Microwave Tunnel Diode and explain two of its applications.

OR

Write in brief, what is transferred electron effect ? In which type of material it is present ? What are the typical characteristics of Gunn diode and explain its working as an oscillator.

4.   Discuss the working of two cavity Klystron amplifier and derive expression for the efficiency of above amplifier starting from basic principles.

OR

Draw the schematic diagram of TWT amplifier and describe its principle of operation. Give the propagation characteristics of different waves generated in the amplifier.

5.   (i)   Compare Micro strip line with strip lines. Write advantages and disadvantages of both.

(ii)   A Micro strip line has following parameters :

$\varepsilon_r = 5.23$, $h = 07$ mil, $t = 2.8$ mil, $w = 10$ mil

Calculate the characteristic impedance of above micro-strip line.

OR

(i)   What is a microwave cavity resonator ? Explain it with suitable diagram and equivalent circuit. Where does it find applications ?

(ii)   An air filled rectangular cavity has following dimensions :

$a = 4$ cms, $b = 2$ cms and $c = 5$ cms. Designate the first five TE and TM modes of oscillations. Find their resonant frequencies.

6. (i) Name microwave devices which make use of Faraday rotation. Explain the construction and working of Circulator.

(ii) Explain the working of Rat race junction.

OR

A four port circulator is constructed of two magic tees and one phase shifter which provide 180° phase shift. Explain how this circulator works.

Phase shifter
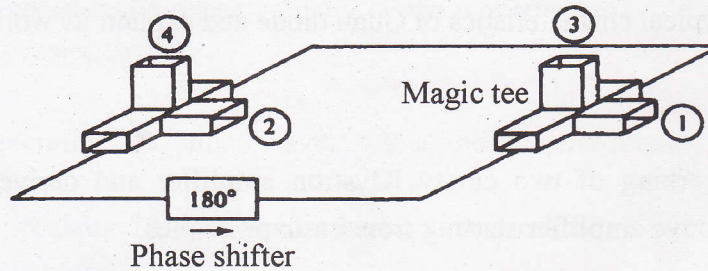
7. How are microwave measurement techniques different from low frequency measurement techniques ? List techniques for measuring microwave power. Describe in detail measurement of medium microwave power.

OR

Determine the transmitter power required in microwave LOS communication system with following specifications :

Carrier Frequency	:	4 GHz
Minimum power at receiver input	:	-65 dBw
Gain of transmitting and receiving antenna each	:	45 dB
Distance between antennas	:	60 km

If the distance between antennas is doubled, what happens to power loss ? Consider only free space loss.

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