B. Tech.

(SEM. VI) THEORY EXAMINATION 2010-11

MICROWAVE ENGINEERING

Time : 3 Hours   *Total Marks : 100*

Note : (1) Attempt **ALL** questions.

(2) Each question carries equal marks.

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

(a) Use Maxwell's equations to show that it is impossible for TEM wave to exist within any conductor wave guide.

(b) An air filled hollow rectangular conducting wave guide has cross-section dimensions of 8×10 cms. How many TE mode will this wave guide transmit at frequencies below 4 GHz ?

(c) For circular wave guide having an internal diameter of 15 cm calculate the cut-off frequencies for (i) $TE_{2,1}$ mode when the roots of the bessel function is 3.05 (ii) $TM_{1,2}$ mode when the roots of the bessel function is 7.02.

(d) An air dielectric rectangular wave guide has inner dimensions of 2 cm by 1 cm. Calculate cut-off frequency for the dominant TE_{10} mode and wave impedance, phase constant and wave velocity at a frequency 1.5 times cut-off frequency.

(e) A lossless parallel strip line has a conducting strip width w. The substrate dielectric separating the two conducting strips has a relative dielectric constant ε_{rd} of 6 (beryllia or beryllium oxide BeO) and a thickness d of 4 mm. Find out the required width w of the conducting strip in order to have a character stick impedance of 50 Ω and also calculate the strip-line capacitance.

(f) What do you mean by microwave cavities ? Describe the Rectangular Cavity Resonator.

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

(a) A two-port network with given scattering parameters is terminated in a load Z_1. Obtain the scattering parameters of the new system.

(b) Classify terminators. Explain each of them with relevant figures.

(c) Explain the working of E Plane Tee. Derive its [S] matrix when the main arm is perfectly matched and Power P is fed from Auxiliary Arm.

(d) Explain the working of Directional coupler and define its four coupling parameters.

(e) Explain the working and applications of circulator. Are they reciprocal or Non reciprocal device ?

(f) What is Faraday Rotation ? How it is used in designing Microwave components ?

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

   (a) What is velocity modulation ? How is it achieved in a two cavity klystron ? Describe the construction and working of a reflex klystron.

   (b) A two-cavity klystron amplifier has the following parameters :

$V_a = 800$ V, $L = 1.5$ mm, $R_{sh} = 15$ k Ω f = 10 GHz, $d = 1$ mm, $L = 4$ cm, $R_{sh} = 30$ k Ω. Calculate : (i) the input voltage for maximum output voltage; (ii) the voltage gain in decibles (iii) efficiency.

   (c) An X-band pulsed cylindrical magnetron has the following operating parameters :

Anode voltage	:	$V_o = 26$ kV
Beam current	:	$I_o = 27$ A
Magnetic flux density	:	$B_o = 0.336$ Wb/m^2
Radius of cathode cylinder :		$a = 5$ cm
Radious off vane edge to center	:	$b = 0$ cm

Compute : (i) the cyclotron angular frequency (ii) the cutoff voltage for a fixed B_o(c) the cutoff magnetic flux density for a fixed V_o.

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

   (a) Explain the working of IMPATT Diode. An IMPATT diode has the following parameters :

Carrier drift velocity	:	$V_d = 2 \times 10^7$ cm/s
Drift-region length	:	$L = 6$ μm

Maximum operating voltage : $V_{omax} = 100$ V

Maximum operating current : $1_{omax} = 200$ mA

Efficiency : $\eta = 15\%$

Breakdown voltage : $V_{bd} = 90$ V

Compute : (i) the maximum CW output power in watts; (ii) the resonant frequency in gigahertz.

(b) What are transferred electron devices ? Explain the working of any one of them.

(c) Explain the operating principle and working of the following :

    (i)   Microwave Bipolar Transistor

    (ii) Microwave tunnel diode.

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

    (a) Working and Application of slotted wave carriage.

    (b) One technique to measure Micro Wave Power.

    (c) With the help of Microwave test bench how to measure the unknown Load.

    (d) How Insertion and attenuation loss of Isolator is measured experimentally.

    (e) Working principle of Crystal detector.

    (f) Working of Frequency meter.