Total number of printed pages – 6

B. Tech

CPEC 5307

Sixth Semester Examination – 2009

MICROWAVE ENGINEERING

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Explain the following : 2×10

   (a) Is a parallel wire transmission line operating at low frequency capable of radiating ? Explain.

   (b) Write down two differences between a parallel wire line and a coaxial line.

P.T.O.

(c) What is (are) the reason(s) for the use of waveguides ?

(d) What a shorted quarter-wave line is analogous to from its operation point of view ? Explain.

(e) Why the TWT is called so ? What makes it suitable as a microwave amplifier ?

(f) What are some of the applications of a cavity reasonator ?

(g) What do you mean by the cut-off field in a magnetron ? What happens if the applied field is more than this ?

(h) What are the Gunn domains ? What do they do ?

(i) What is a horn antenna ? What for it is used ?

(j) What is line-of-sight propagation ? What is its application ?

2. (a) Derive the input impedance of an open-circuited transmission line. What it is equivalent to ? 6

(b) Derive the capacitance of a parallel wire transmission line of width *b* and spacing *a*. 4

3. Derive the cut-off wavelength of a rectangular waveguide from the Maxwell's equations. What are the assumptions made in this derivation ? What is the significance of a cut-off wavelength ? 8+1+1

4. (a) What is a TEM wave ? Can it exist in a waveguide ? Explain. 4

(b) Derive the equations of motion for the TEM wave. What is the lowest value of the cut-off frequency here ? 6

5. Explain the principle and the working of a magnetron with the help of appropriate diagrams. What is the π mode of oscillation ? What is its significance ? 7+2+1

6. (a) What do you understand by excitation of a waveguide ? How is it done ? Explain with the help of neat diagrams. 5

(b) Why a resonant cavity is called so ? Explain its principle and working. 5

7. (a) A certain transmission line has a characteristic impedance of $75+j0.01\ \Omega$ and is terminated in a load of impedance $70+j50\Omega$. Find out

(a) the reflection coefficient and

(b) the transmission coefficient 4

(b) An air-filled rectangular waveguide having dimensions 4×8 operates in the TE_{10} mode. Find out

(a) the cut off frequency and

(b) the phase velocity at a frequency of 4 GHz. 4

(c) A reflex klystron operates with the following conditions ; $V_0 = 600V$, $L = 1mm$, $R_{sh} = 15K\Omega$, $f_r = 9GHz$. The tube is oscillating at f_r at the peak of the $n = 2$ or $1\frac{3}{4}$ mode. Find out the repeller voltage. 2

8. (a) Derive the expression for the squared absolute value of the field strength for a horn antenna that is flared in the plane of the electric field. 6

(b) Explain the attenuation of microwaves. 4