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B. Tech
CPEC 5307

Sixth Semester Examination – 2008

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) What are the three most common types of guiding structures that support TEM waves ?
 - (b) On what factors does the input impedance of a transmission line depend ?

P.T.O.

- (c) What is the significance of purely reactive wave impedance ?
- (d) Which TM mode has the lowest cutoff frequency of all the TM modes in a rectangular waveguide ?
- (e) Which mode is the dominant mode in a rectangular waveguide, when dimension $b < a$?
- (f) What field components exist in a circular cylindrical cavity operating in the TM_{010} mode ?
- (g) What are the limitations of conventional tubes at microwave frequencies ?
- (h) What is beam coupling coefficient in a klystron amplifier ?

- (i) What are different layers of ionosphere ?
- (j) What is critical frequency with respect to an ionosphere layer ?

2. (a) Define voltage reflection coefficient. Is it same as current reflection coefficient ? Explain. 4

(b) On a lossless transmission line terminated in a load $Z_L = 100 \Omega$, the standing wave ratio is measured to be 2.5. Use the Smith chart to find the two possible values of Z_0 . 6

3. (a) Derive field equations of a circular waveguide. Explain why are Bessel functions of the second kind not useful in the analysis of wave propagation in a hollow circular waveguide ? 6

(b) In an air filled square waveguide with dimensions $a = 1.2$ cm, $E_x = -10 \sin(2\pi y/a) \sin(\omega t - 150z)$ V/m. Find

- (i) Mode of propagation,
- (ii) Cut-off wavelength,
- (iii) Calculate the frequency of operation and
- (iv) Wave impedance. 4

4. (a) In relation with directional coupler, define (i) coupling, (ii) directivity and (iii) isolation. How are these factors effect on the performance of a directional coupler ?

5

(b) An E-plane tee has a SWR of 2.25 at port 1. When the other ports are matched terminated, calculate the power delivered to ports 2 and 3, when a matched

generator with an available power of 1 W is connected to port 1. Assume $b_1 = b$.

5

5. Discuss, in brief, with suitable diagram the working of a cavity magnetron. Also, establish the relation for minimum anode potential for a π mode of operation. 10

6. Discuss the principles of the following terms :

(i) Gunn effect (ii) Two valley theory. 4

(b) Describe, in brief, the limited space charge accumulation mode of operation for Gunn diodes. 6

7. Discuss with neat sketches different types of horn antenna. Discuss the application of the horn and give its advantages. 10

8. Write short notes on (any two) : 5×2

(a) Stub matching

(b) Reflex klystron

(c) Line of sight propagation

(d) Measurement of antenna gain.

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