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Total number of printed pages – 3

B. Tech  
CPEC5307

**Sixth Semester (Special) Examination – 2013**

**MICROWAVE ENGINEERING**

**BRANCH : EC**

**QUESTION CODE : E 322**

**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. Answer the following questions : 2×10
- What is the difference between progressive wave and standing wave in a transmission line ?
  - What is the separation between two successive maxima in a transmission line when load is terminated other than  $Z_0$  ? Also mention the separation between maxima and minima.
  - Establish the relationship between reflection coefficient and standing wave ratio.
  - What is an isolator ? What is its significance in microwave applications?
  - Intrinsic impedance is  $377 \Omega$  . Justify.
  - Reflex Klystron is used as an oscillator. Whereas two cavity klystron as an amplifier, why ?
  - Folded dipole is used in Yagi-Yuda antenna. Explain the requirement of other elements of the said antenna.
  - Voltage maxima and current minima occur at the same instant of time. Why ?



P.T.O.

- (i) What do you mean by directivity of an antenna ? Is it dependent on gain of the antenna ? Justify.
- (j) Derive the equation for path loss of an isotropic radiator.
2. (a) A transmission line has the following parameters:-  
 $R = 2 \Omega/m$ ,  $G = 0.5 \text{ mmho/m}$ ,  $f = 1 \text{ GHz}$ ,  $L = 8 \text{ mH/m}$ ,  $C = 0.23 \text{ pF}$   
 Calculate: i) The characteristics impedance, ii) the propagation constant. 5
- (b) A lossless line has a characteristic impedance of  $50 \Omega$  and is terminated in a load resistance of  $75 \Omega$ . The line is energized by a generator which has an output impedance of  $50 \Omega$  and an open circuit output voltage of  $30 \text{ V}$  (rms). The line is assumed to be  $2.25$  wavelengths long. Determine : 5
- (i) The input impedance
- (ii) The magnitude of the instantaneous load voltage.
- (iii) The instantaneous power delivered to the load.
3. (a) Consider a load resistance  $R_L = 100 \Omega$ , to be matched to a  $50 \Omega$  line with a quarter wave transformer. Find the characteristics impedance of the matching section and plot the magnitude of reflection coefficient versus normalized frequency,  $f/f_0$ , Where  $f_0$  is the frequency at which the line is  $\lambda/4$  long. 5
- (b) A lossless transmission line with  $Z_0 = 50 \Omega$  is  $30 \text{ m}$  long and operates at  $2 \text{ MHz}$ . The line is terminated with a load  $Z_L = 60 + j40 \Omega$ . If  $u = 0.6c$  on the line, find by the Smith chart :
- (i) The reflection coefficient  $\Gamma$
- (ii) The standing wave ratio  $s$ ,
- (iii) The input impedance. 5
4. (a) What do you understand by TE and TM wave propagation in a rectangular waveguide? Derive the expression for power transmission of a rectangular waveguide both in  $TE_{mn}$  and  $TM_{mn}$  modes. 5
- (b) An air-filled circular waveguide has a radius of  $2 \text{ cm}$  and is to carry at a frequency of  $10 \text{ GHz}$ . Find all the TE and TM modes for which energy transmission is possible. 5

5. (a) What is a microwave source ? Bring the differences between reflex klystron and two cavity klystron. Which one of these is an oscillator and how It works? Explain with sketches wherever required. 5
- (b) Travelling Wave Tube (TWT) is used in high frequency amplifiers. Justify the requirement of TWT in microwave amplification process. 5
6. (a) An electric field strength of  $10 \mu\text{v/m}$  is to be measured at an observation point  $\theta = \pi / 2$ , 500 km from a half wave(resonant) dipole antenna operating in air at 50 MHz.
- (i) What is the length of the dipole ?
- (ii) Calculate the current that must be fed to the antenna.
- (iii) Find the average power radiated by antenna.
- (iv) If a transmission line with  $Z_0=75\Omega$  is connected to the antenna, determine the standing wave ratio. 5
- (b) What is a directional coupler ? Explain the power divider principle of it with suitable block schematic representation. 5
7. (a) What is a bolometer ? Where is it used ? Explain the technique of microwave power measurement. 5
- (b) Line of sight wave propagation is preferred for high frequency communication. Why ? What are the other modes of radio wave propagation used for communication ? What is critical frequency and how is it determined ? 5
8. Write short notes on any **two** : 5 × 2
- (a) Magnetron
- (b) Gun Oscillators
- (c) Horn Antenna
- (d) Quarter Wave Transformer.

