Total No. of Questions : 10]

SEAT No. :

**P3610**

[Total No. of Pages : 4

# [4959] - 1093
## B.E. (E & TC) (Semester - II)
## Broadband Communication Systems
## (2012 Pattern)

*Time :2½ Hours]* *[Max. Marks :70*

***Instructions to the candidates:-***

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8 and Q.9 or Q.10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***

***Q1)*** a) Explain advantages of optical fibers as communication media. Also state its drawbacks if any. **[6]**

b) Define cut off wavelength of a single mode fiber. Determine the cutoff wavelength for a step index fiber to exhibit single-mode operation when the core refractive index and radius are 1.46 and 4.5 μm, respectively, with the relative index difference being 0.25%. Assume $V_c = 2.405$. **[4]**

OR

***Q2)*** a) A multimode step index fiber has a relative refractive index difference of 1% and a core refractive index of 1.5. The number of modes propagating at a wavelength of 1.3μm is 1100. Estimate the diameter of the fiber core.**[6]**

b) Describe working principle with the aid of simple ray diagram

i) Multimode Step Index Fiber

ii) Graded Index Fiber

Compare advantages and drawbacks of these fibers.

Draw a diagram indicating major possible fiber refractive index profiles for the profile parameter $\alpha = 1, 2$ and $\infty$. **[4]**

***P.T.O.***

***Q3)*** a) An optical fiber system is to be designed to operate over an 8 km length without repeaters. The rise times of the chosen components are: **[6]**

Source (LED): 8 ns

Fiber: intermodal 5 ns $km^{-1}$

(pulse broadening) intra-modal: 1 ns $km^{-1}$

Detector (*p–i–n* photodiode): 6 ns

From system rise time considerations, estimate the maximum bit rate that may be achieved on the link when using an NRZ format.

b) Compare and contrast p-i-n and avalanche photo detectors as optical detector for optical fiber communication. **[4]**

OR

***Q4)*** a) Compare the following optical amplifiers based on working principle, amplification gain and drawbacks. **[6]**

i) SOA

ii) EDFA

b) Compare and contrast LED and ILD as optical source for optical fiber communication. **[4]**

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***Q5)*** a) Which orbital parameter completely specify the orbit? Briefly describe each one of these. **[6]**

b) Verify that geostationary satellite needs to be at a height of about 35780 km above the surface of the Earth. Assume radius of earth to be 6380 km and $\mu = 39.8 \times 10^{13}$ $Nm^2/kg$. **[6]**

c) Explain briefly various look angles for satellite earth station. **[6]**

OR

***Q6)*** a) How does solar eclipse affect satellite communication? **[6]**

b) Determine the maximum possible line of sight distance between two geostationary satellites orbiting the earth at a height of 36000 km above the surface of the Earth. Assume radius of earth to be 6380 km. **[6]**

c) Describe the launch sequence used to inject satellite. **[6]**

*Q7)* a) What are the different components of satellite's power supply subsystem? Briefly describe the role of each component. **[8]**

b) Explain in detail any two of the following for orbital satellite **[8]**

i) Communication Subsystem

ii) Antenna Subsystem

OR

*Q8)* a) Explain double conversion transponder for 14/11 GHz band. Support your answer with suitable diagram and specify frequencies of local oscillators and IF amplifiers. **[8]**

b) Explain Bath-tub curve for probability of failure with reference to satellite. Hence define MTBF. State relation of MTBF with probability of device failure.
Explain various redundancy connections used to mitigate device failure. **[8]**

*Q9)* a) A 4 GHz receiver has the following gains and noise temperatures

$T_{in} = 25$ K, $T_{RF} = 50$ K, $T_{IF} = 1000$ K, $T_m = 500$ K, $G_{RF} = 23$ dB, $G_{IF} = 30$ dB. **[8]**

i) Calculate the system noise temperature assuming that the mixer has a gain $G_m = 0$ dB.

ii) Recalculate the system noise temperature when the mixer has a 10 dB loss.

iii) How can the noise temperature of the receiver be minimized when the mixer has a loss of 10 dB?

iv) The system has an LNA with a gain of 50 dB. A section of lossy waveguide with an attenuation of 2 dB is inserted between the antenna and the RF amplifier. Find the new system noise temperature for a waveguide temperature of 300° K.

b) What do you understand by link budget of a satellite communication link? What type of information do you get from such an analysis'? **[8]**

OR

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***Q10)*** a) Explain various losses in downlink analysis. **[8]**

b) A transponder of a Ku-band satellite has a linear gain of 127 dB and a nominal output power at saturation of 5 W. The satellite's 14 GHz receiving antenna has a gain of 26 dB on axis.

Calculate the power output of an uplink transmitter that gives an output power of I W from the satellite transponder at a frequency of 14.45 GHz when the earth station antenna has a gain of 50 dB and there is a 1.5 dB loss in the waveguide run between the transmitter and antenna. Assume that the atmosphere introduces a loss of 0.5 dB under clear sky conditions and that the earth station is located on the -2 dB contour of the satellite's receiving antenna. If the rain in the path causes attenuation of 7 dB for 0.01% of the year, what output power rating is required for the transmitter to guarantee that a 1 W output can be obtained from the satellite transponder for 99.99% of the year if uplink power control is used? **[8]**

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