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B. Tech

CPEC 5401

Seventh Semester Examination – 2007

COMMUNICATION SYSTEMS

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 in short and to
the point : 2×10
- (a) What are the advantages of single mode
fiber over multi mode fiber ?
- (b) List the factors that contribute to attenu-
ation in optical fibers.

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- (c) The bandwidth of an optical fiber is rated as 10GHz/km. What is the distance over which the fiber can be used to transmit 2GHz signal without the use of a repeater.
- (d) Draw the equivalent circuit of a Photo Diode. (Circuit only)
- (e) Draw the typical wavelength versus attenuation characteristic for an optical fiber.
- (f) Define transponder. What are its uses in a communication satellite system?
- (g) Is it possible to use 100MHz frequency for communication with an artificial communication satellite? Justify.
- (h) List the advantages of using a satellite system for television broadcasting.
- (i) List four different types of antennas used in satellite communication systems.

- (j) A satellite channel has 30MHz bandwidth. How many voice channels can be accommodated in the carrier if FM is used for modulation and the bandwidth occupied by each channel is around 5 times the baseband bandwidth.

2. (a) Analyze how the process of total internal reflection provides a means for sending information over long distances using light energy. Thus show different modes in which light can propagate in optical fibers and list the characteristics of the fibers.

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- (b) What is "V" number for an optical fiber? How is this parameter related to the number of modes in a multimode fiber?

Determine the normalized frequency at $0.82 \mu\text{m}$ for a step index fiber having $25 \mu\text{m}$ core radius, $n_1 = 1.49$ and $n_2 = 1.46$.

How many modes will propagate through this fiber at 830nm and 1550nm wavelength ? 6

3. (a) With the aid of suitable diagram analyze the operation of edge emitting LED source. Discuss the reason for generation of in-coherent optical beam in this device. Analyze the spectral characteristics of the light output from this LED. 5

(b) Analyze the effect of different types of noise affecting a photo detector. Hence using the equivalent circuit derive the relationship for signal to noise ratio for a photo detector. 5

4. (a) An optical fiber communication system is to be designed with a laser transmitter transmitting 0dBm at 1300 nm wavelength. The cable are in rolls of 1 km with attenu-

ation of 1dB/km. Each splice in the link has a attenuation of 1dB and the insertion loss at the transmitter and receivers 2dB each. The link should operate at 1Gbps. Determine the least receiver sensitivity in a 6 dB margin is desired and the link is 20 km in length. Make suitable assumptions if necessary. 5

(b) Analyze with suitable figure any one of the process for manufacturing of single mode fibers. How can two fibers of similar types joined ? 5

5. (a) A typical geo-synchronous satellite is located at 90° W longitude. Determine the look angle from earth station located at 125° W and 37° N. Also determine the northern most and the western most points where the satellite will be visible with an elevation of 25° . 5

(b) Derive the relationship for revolution period of a satellite in terms of its height of deployment. Hence determine the height at which a geosynchronous satellite should be placed. 5

6. An satellite transmits a signal with 30 MHz bandwidth using 33 dBW carrier EIRP. A geosynchronous satellite at 36000km height is assumed using a carrier frequency 3900 MHz. Determine the C/N ratio if :

- (i) Antenna diameter is 4m and 6m with 60% efficiency
- (ii) Antenna noise temperature is 95 K
- (iii) Receiver noise temperature 120 K and 150 K.

The wave guide loss and noise effects in wave guide can be neglected. Make suitable assumption if necessary. Derive the relationship used. 10

7. (a) List different multiple access techniques used in modern satellite systems. Analyze the TDMA system in details. How do multiple earth stations at different distances from satellite synchronize their traffic packets ? 5

(b) Draw the block diagram of a satellite earth station and discuss the functioning of each block. Discuss important features associated with each blocks. 5

8. Write short notes : 10

- (a) Direct broadcast satellite TV.
- (b) Wave-length division multiplexing.
- (c) Splicing of Optical Fibers.