1. ....
Signature of Invigilator

2. ....
Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

CS/M.TECH (ECE)/SEM-2/MMC-203/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JULY – 2009

SATELLITE AND OPTICAL COMMUNICATION (SEMESTER - 2)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. You have to answer the questions in the space provided marked 'Answer Sheet'. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

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FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

Question Number											***Total Marks***	***Examiner's Signature***
Marks Obtained												

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Head-Examiner/Co-Ordinator/Scrutineer

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CS/M.TECH (ECE)/SEM-2/MMC-203/09
SATELLITE AND OPTICAL COMMUNICATION
SEMESTER - 2

Time : 3 Hours] [Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* of the following. $5 \times 14 =$

1. a) Show that the square of the time of revolution of a satellite around the earth is proportional to the third power of the semi-major axis of the orbital ellipse. The earth rotates once per sidereal day of 23hr 56 min 4.09 sec. Hence obtain the orbital radius of the path followed by a satellite in Geostationary Earth Orbit. Given, Kepler's Constant = $3.986004418 \times 10^{5}$ km^{5} /s^{2} . 3 + 3

   b) An earth station is situated in the Northern Hemisphere and there is a geostationary satellite in the southeast direction of the earth station. The latitude and longitude of the earth station are 52.0°N and 0°. The longitude of the geostationary satellite is 66.0°E. Find elevation angle and azimuth angle to the geostationary satellite from the earth station. 4 + 4

2. a) A satellite at a distance of 40,000 km from a point on earth's surface radiates a power of 10 W from an antenna with a gain of 17 dB in the direction of the observer. Find the flux density at the receiving point. If the satellite operates at a frequency of 11 GHz and the receiving antenna has a gain of 52.3 dB, find the received power. Also determine the effective area of the receiving antenna to receive the above determined power. 2 + 3 + 2

   b) Explain the functions of different components of the earth station receiver. Draw the block diagram for the equivalent noise sources in the earth station receiver.

Also obtain the expression for System Noise Temperature of the equivalent noise source. 3 + 2 + 2

3. a) What are the different types of antenna used in satellite ? How the beamwidth of an antenna is related to the dimension of circular aperture of an antenna in the plane in which the pattern is measured ? Calculate the 3 dB beamwidth of the antenna pattern in a given plane for an antenna with circular aperture diameter of 0.75 meter operating at a frequency of 11 GHz. 2 + 2 + 2

b) Consider four earth stations A, B, C and D adopting CDMA techniques with bipolar chip sequences as follows :

A : (− 1 − 1 − 1 + 1 + 1 − 1 + 1 + 1)

B : (− 1 − 1 + 1 − 1 + 1 + 1 + 1 − 1)

C : (− 1 + 1 − 1 + 1 + 1 + 1 − 1 − 1)

D : (− 1 + 1 − 1 − 1 − 1 − 1 + 1 − 1)

The CDMA receiver at the satellite gets the chip : (− 1 + 1 − 3 + 1 − 1 + 1 + 1). Determine the bits sent by each of the station. 8

4. a) Show that power coupling from LED to a step-index optical fiber will be more if the relative refractive index difference is high for the optical fiber. In spite of this fact, why the relative reractive index difference is chosen small for optical fiber ? 4 + 3

b) A step-index multimode fiber with numerical aperture of 0.2 supports approximately 1000 modes at 850 nm wavelength. The velocity of light through the core of the fiber is 2×10^{8} m/s. Determine intermodal dispersion per unit length of the fiber. Calculate critical radius of curvature of the fiber in case of macrobending. 3 + 4

5. a) Explain why Double-heterojunction InGaAsP is preferred over Ge or Si for fabrication of LED. Double-heterojunction InGaAsP LED emitting at peak wavelength 1310 nm has radioactive and nonradiative recombination times 30 ns and 100 ns respectively. The drive current is 40 mA. Determine the internal

power level of the LED. Given, Plank's constant = 6.6256×10^{-34} J.s, charge of an electron = 1.602×10^{-19} C. 3 + 3

b) Why a particular semiconductor material can be used for photodetector over a limited wavelength range ? What will be the effect on Quantum Efficiency and Response Time of a pin photodetector if the lightly n-doped intrinsic region is made thicker ? 2 + 2

c) A data bit stream 11010101 is transmitted using standard CRC method for error detection. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. 4

6. a) A laser source operating at wavelength 1.55 μm with usable spectral band of 80 nm has been used for power coupling to an optical fiber of core diameter 50 μm and numerical aperture 0.2. What will be the optical bandwidth in case of WDM ? Distinguish WDM and DWDM. 2 + 2

b) Show that in a 2 × 2 fiber couple there is a periodic exchange of power between two fibers. Also prove that for a path from input port 1 to output port in *figure* the insertion loss in decibel for the 2 × 2 fiber coupler is sum of coupling ratio and excess loss. 3 + 3

Fig.

c) What is the power margin between the transmitter and the receiver of two stations in fiber optic star network ? There is a star network containing 50 stations in which station is located at a distance of 500 metres from the star coupler and fiber attenuation is 0.4 dB/km. If excess loss and connector loss in the network be 1.25 dB and 1.0 dB respectively, determine the power margin between the transmitter and the receiver of two stations in the star network.

2 + 2

7. Write short notes on any *two* of the following : 2 × 7

a) Role of transponders in satellite

b) Altitude and orbit control in satellite communications

c) Multichannel frequency modulation in analog fiber optic link

d) SONET/SDH rings and networks.

END