



UNIVERSITY OF MORATUWA
Faculty of Information Technology

B.Sc. (Hons) in Information Technology
Level 1 – Semester 2 Examination

IN1500 Data Communication

Time Allowed: $2\frac{1}{2}$ hours

March 2016

ADDITIONAL MATERIAL

None

INSTRUCTIONS TO CANDIDATES

1. This paper contains five (5) pages (including this page).
2. This paper comprises two (2) sections, namely Section A and Section B.
3. Section A contains five (5) short answer questions and Section B contains three (3) essay type questions.
4. The total marks obtainable for this examination is 100. The marks assigned for each Question & Sections thereof are included in brackets.
5. This examination accounts for 60% of the module assessment.
6. This is a closed book examination.
7. All the workings need to be shown very clearly.
8. Answer **ALL Questions in both Sections A & B.**
9. Answer Section A and B in **separate** booklets and tie them together.
10. Non programmable scientific calculators are allowed.

Continued...

Section A

Answer all questions, clearly showing the workings.

(All complete and correct answer will carry 5 Marks each)

Q1: Determine the efficiency of the following data link connecting two remote offices of a multinational corporation. The parameters of the link are as follows:

Distance between the offices: 253 km

Bandwidth of the link: 1.544 Mbps

Number of packets transmitted per second: 75

Bit Error Rate (BER) of the link: 10^{-6}

Average size of data packets: 2048 bytes

Note: The entire packet is dropped and retransmitted, when a bit error is detected in a packet.

Q2: A wireless point to point link has been used to carry a data channel between two cities. Calculate the received signal power at the receiver given the following link parameters.

Length of the link: 55km

Gains of the Antennas: 50 dBi

Transmission frequency: 1800 MHz

Transmitted power: 5W

Q3: A multimode step index optical fiber has been used to connect two cities separated by a distance of 25 km. Calculate the maximum delay between the two signals travelling the longest distance and the shortest distance within the fiber given the following parameters.

Speed of light in free space: 3×10^8 m/s

Refractive index of the core: 1.5

Refractive index of the cladding: 1.2

Diameter of the core: 50 μm

Continued...

Q4: Given the following information on free space transmission of a signal, calculate the maximum possible transmission distance.

Signal frequency: 2.6 GHz

Transmission power: 10 W

Antenna gains (at both ends): 1 dB

Required minimum signal to noise ratio: 1

Noise level at the receiver end: -90 dBm

Q5: Find the Fourier series of the function.

$$f(x) = \begin{cases} x & -\pi \leq x \leq +\pi \\ 0 & \text{Otherwise} \end{cases}$$

End of Section A

Section B

Answer all questions.

Question 1

- (a) Define the term "Line of Sight". (5 Marks)
- (b) What is the predominant type of loss encountered by a signal in satellite communication? (5 Marks)
- (c) Compute the typical time delay encountered by a signal in a satellite channel that uses a geosynchronous satellite. (Geosynchronous satellites are positioned above the earth at a distance of around 36,000 km) (5 Marks)
- (d) Compute the minimum receiver sensitivity at the satellite receiver in dBms, given the following information.

✓Transmit power: 850W

✓Transmit waveguide loss: 2 dB

✓Transmit antenna gain: 50.6 dBi

✓Receive antenna gain: 26.3 dBi

✓Receive waveguide loss: 0.5 dB

Antenna alignment loss: 1 dB

Fade Margin: 10dB

Additional atmospheric loss: 5dB

Transmit Frequency: 6 GHz

Satellite orbit height: 36,000 km

(10 Marks)

Question 2

- (a) Briefly discuss the different digital-to-digital encoding techniques used in data communication. (6 Marks)
- (b) Compare and contrast the unipolar encoding with bipolar encoding. (6 Marks)
- (c) What are the disadvantages of Pulse Code Modulation (PCM) compared to other coding techniques? (3 Marks)
- (d) Derive the required transmission bandwidth from first principles given the following information.

Maximum bandwidth of the source signal: 5 MHz

Quantization levels required: 65536

Type of coding used: PCM

(10 Marks)

Question 3

- (a) Briefly discuss the advantages and disadvantages of guided media over unguided media. (5 Marks)
- (b) Compare and contrast step-index fiber with that of graded-index fiber. (5 Marks)
- (c) Compute the maximum distance that can be covered with a step index multimode fiber with the following parameters.

Data rate of the signal: 1 Mbps

Diameter of the core/cladding: 50/125 μm

Refractive index of core relative to the cladding: 1.5

Type of source: single frequency laser

Speed of light in the core: 2.0×10^8 m/s

Type of signal coding: Non Return to Zero (NRZ)

Maximum dispersion allowed: half the period of a bit.

(15 Marks)

End of Section B

End of Paper