

# ICT209 Computer Communications - Data Communications

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## Tutor-marked Assignment 01

For Jan 09 Semester Presentation

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**Question 1 [20 marks]**

Consider a channel with a bandwidth of 1 MHz and a signal-to-noise ratio of 18 decibel.

- (a) Calculate the signal-to-noise ratio in Watt/Watt.
- (b) What is the upper limit to the data rate that the channel can carry?
- (c) However, for practical reasons, better error performance can be achieved at a lower data rate. Assume we choose a data rate of  $\frac{2}{3}$  the maximum theoretical limit obtained in (b). How many signal levels are needed to achieve this data rate?

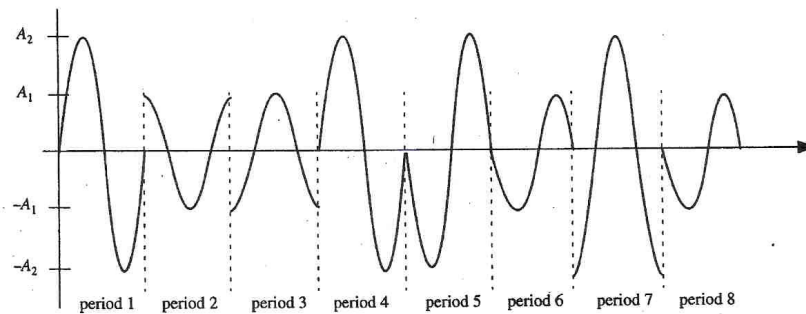
[(a) 6 marks, (b) 7 marks (c) 7 marks, total 20 marks]

## Question 2 [20 marks]

Consider a modem using *differential Quadrature Amplitude Modulation* (2 amplitudes and 4 phases) technique as defined in the following table:

Symbol	Sine Wave Amplitude ( $A_1 < A_2$ )	Phase shift (with reference to previous signal)
000	$A_1$	0
001	$A_2$	0
010	$A_1$	$1/(4f)$
011	$A_2$	$1/(4f)$
100	$A_1$	$2/(4f)$
101	$A_2$	$2/(4f)$
110	$A_1$	$3/(4f)$
111	$A_2$	$3/(4f)$

Each symbol is represented by one complete cycle of a sine wave  $A \sin(2\pi ft)$ , where the peak amplitude  $A$ , is either  $A_1$  or  $A_2$  volts and  $f$  is the frequency. Given the QAM analog waveform below, determine the bit sequence that corresponds to the signal waveform in various periods.



[2.5 marks for each period, total 20 marks]

### Question 3 [20 marks]

Consider a transmission system using Cyclic Redundancy Check (CRC) technique with a generator polynomial **10101**. The receiver receives the following bit pattern: **100111011000**.

- (a) Draw a digital logic circuit for a shift register implementation of CRC.

[8 marks]

- (b) Use the logic to evaluate the received bit pattern to see whether the bit pattern is error-free.

[12 marks]

### Question 4 [20 marks]

Consider the transmission of 1000-bit frames on a 1 Mbps satellite channel with a one-way station-to-station propagation delay of 270 ms. Assume that the processing delay and the acknowledgement frame length are small enough to be neglected and that the channel is error free. What is the maximum link utilization for

- (a) Stop-and-wait flow control?
- (b) Continuous flow control with a window size of 7?
- (c) Continuous flow control with a window size of 255?

[(a) 6 marks, (b) and (c) 7 marks each, total 20 marks]

**Question 5 [20 marks]**

(a) Consider the HDLC NRM operation with a window size of 7. The primary station has sent six I-frames to a secondary. The primary's N(S) count was three (011 binary) prior to sending the six frames. If the poll bit is on the sixth frame, what will be the N(R) count back from the secondary after the last frame? Assume error-free operation.

[10 marks]

(b) The start and stop bits can be eliminated when character interleaving is used in synchronous TDM. Explain the reason.

[10 marks]

***END OF TMA01***