UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE	:	SAB36303
COURSE NAME	:	TELECOMMUNICATION SYSTEM
PROGRAMME LEVEL	:	BACHELOR
DATE	:	30 JANUARY 2026
TIME	:	9.00 AM – 11.30 AM
DURATION	:	2 HOURS AND 30 MINUTES

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of FIVE (5) questions.
4. Answer ONLY FOUR (4) questions.
5. Please write your answers on answer booklet provided.
6. Answer all questions in English language ONLY.

(Total: 100 marks)

INSTRUCTION: Answer FOUR (4) questions only.
Please use the answer booklet provided.

Question 1

(a) Calculate and draw the bandwidth of a signal that decomposed into five (5) sine waves with frequencies at 0, 20, 50, 100 and 200 Hz, with all peak amplitudes being the same.

(5 marks)

(b) Find the bit rate for each of the following signals.

i. A signal in which 1 bit lasts 2 ms.

(2 marks)

ii. A signal in which 10 bits last 20 μs

(2 marks)

(c) A file contains 2 million bytes. Compute the time it takes to download the file using a 56 Kbps channel. Compare the result if the bandwidth is increased to 1 Mbps.

(6 marks)

(d) A frame of size 5 million bits is being sent on a link with 10 routers, each having a queuing time of 2 μs and a processing time of 1 μs. The length of the link is 2000 Km. The speed of light in the link is 2×10^8 m/s. The link has a bandwidth of 5 Mbps. Find

i. latency (total delay) for the frame to arrive at the destination.

(7 marks)

ii. Component of the latency that is dominant.

(3 marks)

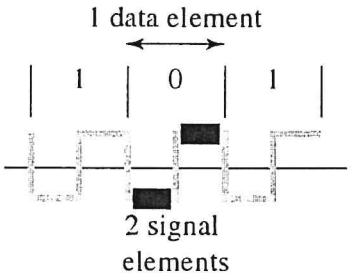
Question 2

(a) Distinguish between a signal element and a data element.

(4 marks)

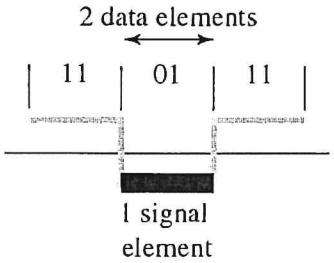
(b) Calculate the signal rate for each case in Figure 1 if the data rate is 1Mbps and c=1/2.

i.



(3 marks)

ii.



(3 marks)

Figure 1: Signal element versus data element

(c) Consider a stream of binary data consisting of bits 11100000000000 is transmitted using a scrambling technique. Assume that the last non-zero signal level before the bitstream has been positive.

i. Discuss the purpose and method of the scrambling technique.

(5 marks)

ii. Sketch the waveform of the output signal if the scrambling technique used is **B8ZS**.

(5 marks)

iii. Sketch the waveform of the output signal if the scrambling technique used is **HDB3**.

(5 marks)

Question 3

(a) Consider a stream of binary data consisting of bits 0011001101 that is transmitted using the NRZ-I scheme.

i. Draw the waveform for the bit pattern. Assume the last signal level before these bits has been positive.

(5 marks)

ii. Find the signal rate for the average case for this scheme.

(3 marks)

(b) A low-pass signal with a bandwidth of 200 kHz has been sampled and quantized by using 1024 levels of quantization.

i. Calculate the sampling frequency of the signal.

(3 marks)

ii. Calculate the bit rate of the digitized signal.

(4 marks)

iii. If the amplitude of the signal ranges from -20V to +20V, calculate the maximum quantization error in the process.

(6 marks)

iv. State the final encoded word for the signal values in the quantization (zone) code 5.

(4 marks)

Question 4

(a) Define the following terms

i. Digital to analog conversion

(2 marks)

ii. Analog to analog conversion

(2 marks)

(b) Draw the constellation diagram for the 8-QAM with two (2) different peak amplitude values, 1 and 3, and four different phases.

(5 marks)

(c) Calculate

i. The baud rate for 36000 bps, 64-QAM

(3 marks)

ii. The bit rate for 1000 baud, FSK

(3 marks)

(d) A corporation has a medium with a 1 MHz bandwidth (low pass). The corporation needs to create 10 separate independent channels, each capable of sending at least 10 Mbps. The company has decided to use QAM technology. Find

i. The minimum number of bits per baud for each channel.

(5 marks)

ii. The number of points in the constellation diagram for each channel.

(5 marks)

Assume d=0.

Question 5

(a) By referring to Figure 2,

i. Describe the purpose of multiplexing and demultiplexing.

(4 marks)

ii. Describe the process of frequency-division multiplexing

(4 marks)

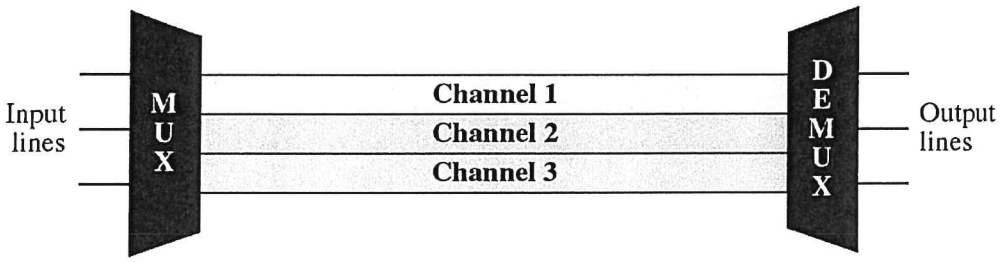


Figure 2: Frequency-division multiplexing

(b) Five (5) channels, each with a 200-kHz bandwidth, are to be multiplexed together on a single analog satellite link.

i. Calculate the bandwidth of the satellite link if there is a guard band of 10 kHz between channels to prevent interference.

(3 marks)

ii. Sketch the diagram of the bandwidth for the multiplexed link based on the result above.

(4 marks)

iii. Given five (5) digital inputs, each transmitting at 1 Mbps to use the satellite link, calculate the suitable QAM modulation type.

(5 marks)

(c) Define frequency hopping spread spectrum (FHSS) and explain how it achieves bandwidth spreading.

(5 marks)

END OF EXAMINATION PAPER