



SCHOOL OF COMPUTING AND ENGINEERING SCIENCES  
BACHELOR OF COMPUTER NETWORKS AND SECURITY  
END OF SEMESTER EXAMINATION

BTC2105: VOICE AND DATA COMMUNICATION

DATE: 30<sup>TH</sup> April 2026

Time: 1330-15.30

**Instructions**

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

**QUESTION ONE (30 MARKS-COMPULSARY)**

- a) Distinguish between datagram packet switching and virtual packet switching (2 marks)
- b) A carrier signal  $c(t) = 50 \cos(2\pi \times 10^5 t)$  is amplitude modulated by a message signal  $m(t) = 10 \cos(2\pi \times 10^3 t)$ . Determine the:
  - i. Modulation index. (2 marks)
  - ii. Carrier power. (2 marks)
  - iii. Power in the modulated AM wave (2 marks)
  - iv. Transmission efficiency (2 marks)
  - v. Transmission bandwidth (2 marks)
- c) Draw a block diagram of an FM transmitter using a PM generator. The block diagram should be made up of two blocks (2 marks)
- d) State **two** reasons for the use of line codes in baseband signal transmission (2 marks)
- e) A voice signal of frequency range 0 – 4 kHz is to be digitized through PCM. It is quantized to 256 levels. Given that the sampling rate is twice the Nyquist rate, determine each of the following:
  - i. Number of bits used to encode each level (2 marks)
  - ii. Transmission bit rate (2 marks)

- f) State Shannon's channel capacity formula, explaining the meaning of all the symbols used in the formula. **(3 marks)**
- g) Determine the channel capacity for a signal of bandwidth 3100 Hz, signal power of 0.2 W and noise power of 0.002W **(4 marks)**
- h) Figure 1 shows a simplified diagram of a GSM network
- State the frequency range used for communication between A and C **(1 marks)**
  - Briefly explain the process of establishing a connection between A and B **(4 marks)**

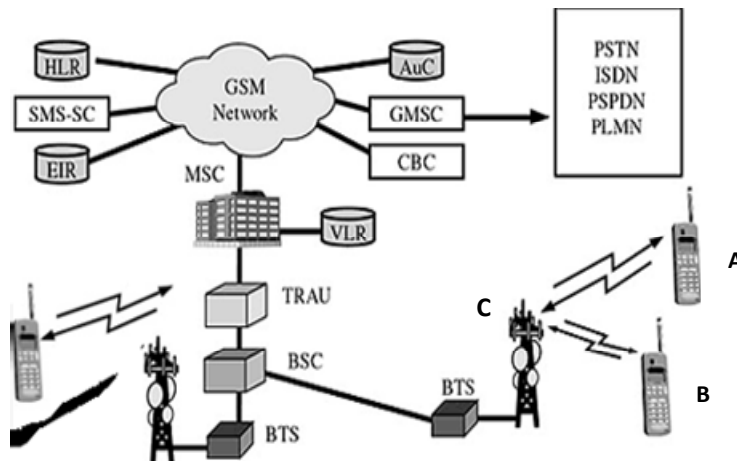


Figure 1

## QUESTION 2 (15 MARKS)

- a) Explain the importance of considering the following factors in line encoding
- Cost and Complexity **(1 mark)**
  - Signal spectrum **(1 mark)**
- b) A data sequence 11010001100001 is to be encoded using a line code. On the same axis, draw the waveforms for each of the following line encoding schemes:
- Manchester **(2 marks)**
  - Differential Manchester **(2 marks)**
  - Bipolar AMI **(2 marks)**
- c) A voice signal in the frequency range of 0 – 4 kHz is sampled at the Nyquist rate. It is transmitted through a PCM system. A signal to quantization noise ratio of 60 dB is desired. Determine each of the following:
- Number of bits required to encode each bit **(2 marks)**
  - Number of quantization levels **(2 marks)**
  - Bit rate **(1 mark)**

iv. Bandwidth occupied by the PCM signal

(2 marks)

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**QUESTION 3 (15 MARKS)**

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a) Explain the role of a modem in Data networks

(3 marks)

b) Distinguish between baud rate and modulation rate

(2 marks)

c) Describe each of the following modulation schemes

i. Amplitude shift Keying

(2 marks)

ii. Frequency shift Keying

(2 marks)

d) A binary FSK has a mark frequency of 49 kHz and a space frequency of 51kHz. The input bitrate is 2 kbps. Determine the:

i. Peak frequency modulation

(2 marks)

ii. Minimum bandwidth

(2 marks)

iii. Baud rate

(2 marks)

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**QUESTION 4 (15 MARKS)**

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a) Describe each of the following transmission impairments

i. Attenuation

ii. Delay distortion

iii. Noise

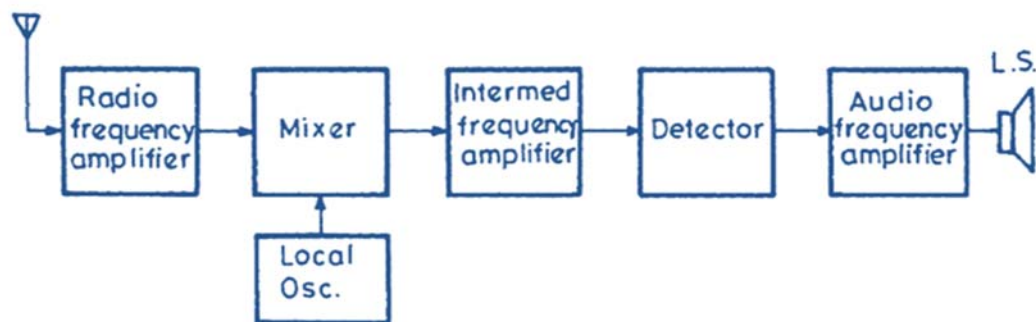
(3 Marks)

b) Figure 2 shows a super heterodyne radio receiver. Explain the function of the following blocks

i. Mixer

ii. Intermediate Frequency amplifier

(4 marks)



**Figure 2**

c) Distinguish between frequency modulation and phase modulation techniques

(2 marks)

d) A 6V 3 MHz sinusoidal carrier is frequency modulated by a 2.5 400Hz audio sine wave and the resulting deviation is 7.5 KHz. Determine the

i. Modulation index

(2 marks)

ii. Bandwidth of the modulated signal

(2 marks)

iii. Sensitivity of the modulator (2 marks)

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**QUESTION 5 (15 marks)**

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a) Describe the operation of message switching network

(4 marks)

b) Draw the diagram of an RTP packet header and describe the function of any three fields of the header.

(8 marks)

c) State **three** challenges experienced in transmitting voice over packet switched networks

(3 marks)