

**KABARAK**



**UNIVERSITY**

**UNIVERSITY EXAMINATIONS**

**2009/2010 ACADEMIC YEAR**

**FOR THE DEGREE OF BACHELOR OF COMPUTER SCIENCE**

**COURSE CODE: COMP 222**

**COURSE TITLE: TELECOMMUNICATIONS AND  
COMPUTERS**

**STREAM: Y2S2**

**DAY: MONDAY**

**TIME: 2.00 – 4.00 P.M.**

**DATE: 02/08/2010**

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**INSTRUCTIONS:**

- Answer **ALL** the questions in **PART ONE** and any **TWO** questions in **PART TWO**.

**PLEASE TURNOVER**

## PART ONE

### QUESTION ONE (30 MARKS)

- a. A transmission channel has a signal to noise ratio of 3090. The transmission channel can transmit signals with frequencies between 4560 Hz and 9900 Hz. Use the Shannon capacity formula to determine the theoretical highest data rate for this channel. (3 marks)
- b. An electromagnetic wave has a frequency of 1 GHz. Calculate its
  - i. Period (2 marks)
  - ii. Wavelength (2 marks)
- c. An analog signal is converted to a digital signal using PCM. The analog signal is first sampled at uniform intervals to give the following pulses.

Table A

Time (seconds)	0	0.00005	0.00010	0.00015	0.00020	0.00025	0.00030	0.00035	0.00040	0.00045
Sample amplitude (volts)	1.4	4.2	5.1	8.8	11.9	15.3	18.7	22.5	24.1	26.6

The pulses are then quantized with a quantizer using the following quantization levels.

Table B

Quantization levels (volts)	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
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The quantized pulses are then binary encoded by a binary encoder.

- i. What is the sampling interval? (1 mark)
  - ii. Calculate the sampling rate (2 marks)
  - iii. Determine the quantized pulse level, for each of the sampled pulses in table A. (5 marks)
  - iv. Calculate the bit rate of the resultant digital signal (4 marks)
- d. What is digital transmission? (1 mark)
  - e. What is line coding? (1 mark)
  - f. For each of the following line codes; Manchester code and the unipolar code, determine if they are;
    - i. Self synchronizing (2 mark)
    - ii. Has a residual DC component (2 mark)
  - g. For the following binary data  
011001110101  
Draw the
    - i. Manchester code (3 marks)
    - ii. Unipolar code (2 marks)

## PART TWO

### QUESTION TWO (20 MARKS)

- a. Describe
  - i. Frequency shift keying (4 marks)
  - ii. Frequency modulation (3 marks)
- b. What is half duplex transmission? (1 mark)
- c. What is full duplex transmission? (1 mark)
- d. A transmission channel has a bandwidth of 5500 Hz. You are required to provide full duplex transmission between two devices, with a guard band of 500 Hz between the two directions. Amplitude shift keying is to be used as the modulation scheme. Calculate
  - i. The bandwidth in Hz available for data transmission in each direction (2 marks)
  - ii. The frequency of each carrier signal that is used for modulation in each direction (3 marks)
  - iii. The baud rate in each direction (2 mark)
  - iv. The bit rate in each direction (2 marks)
  - v. The bit rate in each direction if 16 Quadrature Amplitude Modulation is used instead (2 marks)

### QUESTION THREE (20 MARKS)

- a. What does the term burst error mean? (1 mark)
- b. With regard to simple parity check what is meant by;
  - i. Odd parity (2 marks)
  - ii. Even parity (2 marks)
- c. How many errors can be detected using simple parity check? (1 mark)
- d. The following block of 16 bits is to be sent along with a checksum of 8 bits for error detection purposes.  
0110010111110101  
Use the checksum generator to generate the checksum bits, (3 marks)
- e. A receiver receives the following pattern of bits.  
101010010011111100011101  
The bits consist of 16 data bits and eight checksum bits. Use the checksum checker to determine if any errors occurred during transmission. (5 marks)
- f. What is error control? (3 marks)
- g. What is forward error correction? (3 marks)

#### QUESTION FOUR (20 MARKS)

- a. Time division multiplexing is used to multiplex ten lines each transmitting at the rate of 1600 bits per second. The multiplexed signal is then transmitted on a link whereby each time slot in the transmitted frames is 4 bits long. Calculate
- i. The bit interval on each of the four lines (2 marks)
  - ii. The bit interval on the link carrying the TDM signal (2 marks)
  - iii. The duration of a time slot (2 marks)
  - iv. Duration of a frame (3 marks)
  - v. The bit rate of the multiplexed signal (2 marks)
- b. 5 signals are frequency division multiplexed. Each signal has a bandwidth of 4200 Hz. A guard band of 200 Hz is used to separate the FDM bands. Calculate the minimum bandwidth required for the FDM signal. (4 marks)
- c. What is channelization? (2 marks)
- d. Describe frequency division multiple access (FDMA) (3 marks)