

May 7, 2002

COMPUTER ENGINEERING DEPARTMENT

COE 342

DATA & COMPUTER COMMUNICATIONS

Major Exam II

Second Semester (012)

Time: 5:00-7:00 PM

Student Name : _____

Student ID. : _____

Question	Max Points	Score
Q1	60	
Q2	10	
Q3	18	
Q4	12	
Total	100	

Dr. Aiman El-Maleh

[60 Points]

(Q1) Indicate whether the following is true or false, and if it is false correct it:

- (1) (True, False) According to the sampling theorem, the least sampling frequency for a signal whose spectrum is [2400Hz, 6500Hz] is 8.2 KHz.

- (2) (True, False) The maximum data rate of a QAM modulator using 16 levels for each phase over the telephone network is 20 Kbps. Assume that $r=0$.

- (3) (True, False) Using Differential Manchester encoding, the minimum bandwidth needed for data transmission at a rate of 100 Mbps is 100 MHz.

- (4) (True, False) Assume that a PSK technique encodes a signal by using the following phases: 0° , 45° , 90° , 135° , 180° , 225° , 270° and 315° . With a baud rate of 45 Mbauds, the maximum data rate is 360 Mbps.

- (5) (True, False) In optical fiber transmission, attenuation due to scattering increases with the increase in the frequency.

- (6) (True, False) Repeaters or amplifiers may be placed farther apart for twisted pair and coaxial cable than for microwave systems.

- (7) (True, False) Assume that an FSK signal is transmitting at 19.2 Kbps in half-duplex mode where the carrier frequencies f_1 and f_2 are separated by 30 KHz. The minimum bandwidth for the signal is 38.4 KHz. Assume that $r=0$.
- (8) (True, False) The minimum bandwidth for a 4-PSK signal (4 phase shifts are used) transmitting at 2 Kbps in half duplex mode is 4 KHz. Assume that $r=0$.
- (9) (True, False) Suppose that a single frequency carrier signal at frequency $f_c=1$ MHz is AM modulated by a data signal $x(t)$ whose spectrum extends from 100 KHz to 200 KHz. The bandwidth of the AM modulated signal is 200 KHz.
- (10) (True, False) In satellite transmission, the same frequency band is used for transmission from earth to satellite (uplink) and from satellite to earth (downlink).
- (11) (True, False) In Delta modulation, decreasing the step size always improves the quality of the encoded signal.
- (12) (True, False) Transmitting a voice signal as a digital signal using Pulse Code Modulation with 128 levels requires a bandwidth of 56 KHz.

- (13) (True, False) NRZ-L encoding requires higher bandwidth than Differential Manchester encoding.
- (14) (True, False) Attenuation for twisted pair and coaxial cable increases with frequency.
- (15) (True, False) For long distance digital point-to-point signaling, data rates up to 1 Gbps can be achieved using twisted pairs.
- (16) (True, False) Category 5 UTP cables have a bandwidth up to 20 MHz.
- (17) (True, False) Category 3 and Category 5 UTP cables have the same number of twists per unit distance and the same attenuation level.
- (18) (True, False) In optical fiber, using 1500nm wavelength provides higher data rates and longer distances than 850nm wavelength.

- (19) (True, False) Multi-mode fiber has higher bandwidth than single-mode fiber and can be used over longer distances.
- (20) (True, False) Microwave frequencies are in the range of about 2 MHz to 40 MHz.
- (21) (True, False) Two microwave antennas at a height of 150 m may be as far as 101Km.
- (22) (True, False) The optimum frequency range for satellite transmission is below 1 GHz.
- (23) (True, False) For satellite transmission, frequency bands higher than 10 GHz experience greater attenuation problems but allow greater bandwidth and smaller and cheaper receivers.
- (24) (True, False) Radio wave signals suffer the same attenuation level as microwave signals for the same distance.

- (25) (True, False) For the same bit error rate, multilevel binary encoding techniques require less signal power than two-level binary encoding techniques.
- (26) (True, False) The following signal is an example of ASK.
- $$s(t) = \begin{cases} -\cos(2000\pi t) & \text{binary 1} \\ \cos(2000\pi t) & \text{binary 0} \end{cases}$$
- (27) (True, False) In AM, the amplitude of the input signal should be larger than the amplitude of the carrier signal so that most of the signal power is used to carry information.
- (28) (True, False) Using an 8-bit chipping code in direct sequence spread spectrum spreads the signal across a frequency band that is 4 times greater than a 2-bit chipping code.
- (29) (True, False) Biphase encoding techniques (e.g. Manchester) have the advantage of providing synchronization between the transmitter and the receiver and error detection capability.
- (30) (True, False) The maximum data rate that can be obtained over a voice grade telephone line with signal to noise power ratio equal to 20 dB and $E_b/N_0=10$ dB is 40 Kbps.

[10 Points]

(Q2) Given the bit stream 1 0 0 0 0 1 1 0 0 0 0 1, sketch the waveform for each of the coding techniques given below. Assume that the reference signal level is a negative voltage.

	1	0	0	0	0	1	1	0	0	0	0	1
NRZI												
B8ZS												
Manchester												
Differential Manchester												
HDB3												

[18 Points]

(Q3) An analog signal has voltage values in the range of 0 to 5 Volts. Suppose that the analog signal is sampled and the following sequence of voltages is produced: 0.75, 1.2, 1.6, 2.6, 3.85, 1.6, 1.1, 0.9, 0.6, 0.4

(i) Assume that a 3-bit PCM codec is used.

1. Into how many groups does this 3-bit codec divide the input voltage.
2. Give the analog voltages and the corresponding digital values that will be used by this 3-bit codec.
3. What is the quantization error of this 3-bit codec.
4. What bit stream the PCM codec will produce for the given sampled voltages.
5. Determine the voltages that the receiver PCM codec will produce for the received bit stream.
6. Approximately, how many decibels are gained by the addition of an extra bit i.e., using a 4-bit codec.

(ii) Assume that a Delta Modulation codec is used with a step size δ equal to 1 v. Assume that the starting reference voltage is 0 v.

1. What bit stream the DM codec will produce for the given sampled voltages.
2. Determine the voltages that the receiver DM codec will produce for the received bit stream.

[12 Points]

(Q4) Given an input signal $x(t) = \cos(4\pi t)$ used to modulate a carrier signal $y(t) = \cos(100\pi t)$. Give the equation of the modulated signal $s(t)$ for each of the modulation techniques given below. Furthermore, determine the frequency components in the frequency spectrum of the modulated signal.

(i) Double Sideband Transmitted Carrier Amplitude Modulation.

(ii) Double Sideband Suppressed Carrier Amplitude Modulation.

(iii) Phase Modulation.

(iv) Frequency Modulation.