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Ahsanullah University of Science and Technology

Department of Computer Science and Engineering

Year: 3rd, Semester: 2nd, Final Examination (Spring 2017)

Course No: CSE 3211 Course Title: Data Communications
Full Marks: 70 Time: 3 Hours

[There are seven (7) questions. Answer any five (5) questions.]

[Marks allotted are indicated in the margin]

Q1. a) What is the phase shift for the following? 3

i) A sine wave with the maximum amplitude at time zero
ii) A sine wave with maximum amplitude after 1/4 cycle
iii) A sine wave with zero amplitude after 3/4 cycle and increasing

b) What is the bandwidth of a signal that can be decomposed into five sine waves with frequencies at 0, 20, 50, 100, and 200 Hz? All peak amplitudes are the same. Draw the bandwidth. 2

c) A computer monitor has a resolution of 1200 by 1000 pixels. If each pixel uses 1024 colors, how many bits are needed to send the complete contents of a screen? 2

d) We need to upgrade a channel to a higher bandwidth. Answer the following questions: 4

i) How is the rate improved if we double the bandwidth?
ii) How is the rate improved if we double the SNR?

e) 3

i) What does the Nyquist theorem have to do with communications?
ii) What does the Shannon capacity have to do with communications?

Q2. a) In a digital transmission, the sender clock is 0.2 percent faster than the receiver clock. How many extra bits per second does the sender send if the data rate is 1 Mbps?. 2

b) We need to send data at a 1-Mbps rate. We have two options- i) a combination of 4B/5B and NRZ-I and ii) Manchester encoding. Compare and contrast the two options in terms of required bandwidth and dc component. 4

c) How do scrambling techniques overcome the baseline wandering problem of AMI encoding? 2

d) We have sampled a low-pass signal with a bandwidth of 200 KHz using 1024 levels of quantization. 6

i) Calculate the bit rate of the digitized signal.
ii) Calculate the SNR_{dB} for this signal.
iii) Calculate the PCM bandwidth of this signal.

$B = 2N \cdot \log_2 L$

Q3. a) Which characteristics of an analog signal are changed to represent the low pass analog signal in each of the following analog-to-analog conversions? 3

p) AM q) FM r) PM

b) Which of the three analog-to-analog conversion techniques (AM, FM, or PM) is the most susceptible to noise? Defend your answer. 3

c) A corporation has a medium with a 1-MHz bandwidth (lowpass). 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. What is the minimum number of bits per baud for each channel? What is the number of points in the constellation diagram for each channel? Let d = 0. 4

d) Draw the constellation diagram for the following: 4

i) ASK, with peak amplitude values of 1 and 3
ii) BPSK, with a peak amplitude value of 2
iii) QPSK, with a peak amplitude value of 3
iv) 8-QAM with two different peak amplitude values, 1 and 3, and four different phases

Q4. a) Four channels, two with a bit rate of 200 kbps and two with a bit rate of 150 kbps, are to be multiplexed using multiple-slot TDM with no synchronization bits. Answer the following questions: 6

i) What is the size of a frame in bits?
ii) What is the frame rate?
iii) What is the duration of a frame?
iv) What is the data rate?

b) An FHSS system uses a 4-bit PN sequence. If the bit rate of the PN is 64 bits per second, answer the following questions:

i) What is the total number of possible channels? 1
ii) What is the time needed to finish a complete cycle of PN? 1

c) i) Show the band allocation (data and video) in CATV. 2
ii) Determine the upstream and downstream data rate. 2
iii) How do the downstream bands are shared among the subscribers? 2

Q5. a) i) What is Hamming distance? 1
ii) How does error detection take place in forward error detection? 2
iii) How does error correction take place in forward error correction? 2
iv) Make comments on overhead in forward error corrections. 1

b) i) In CRC, which of the following generators (divisors) guarantees the detection of a single bit error? 2

p) 101 q) 100 r) 1

ii) In CRC, which of the following generators (divisors) guarantees the detection of an odd number of errors? 3

p) 10111 q) 101101 r) 111

iii) In CRC, we have chosen the generator 1100101. What is the probability of detecting a burst error of length 3

p) 5? q) 7 r) 10?

Q6. a) Define a frame format in bit-oriented protocol. Show the bit stuffing and unstuffing for the data - 00011111111000111110011 3

b) How do flow control and error control are achieved in the following protocols? 5

i) Stop and Wait ARQ
ii) Go-Back-N ARQ

c) Using 4-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols? 6

i) Stop-and-Wait ARQ

ii) Go-Back-N ARQ

iii) Selective-Repeat ARQ

Defend your answer.

7. a) i) Why does a circuit-switched network need end-to-end addressing during the setup and teardown phases? Why are no addresses needed during the data transfer phase for this type of network? 2

ii) Why does a datagram network need only end-to-end addressing during the data transfer phase? 1

iii) Why does a virtual-circuit network need addresses during all three phases (setup, data transfer and teardown)? 1

b) We need a three-stage space-division switch with $N = 100$. Answer the following questions using Clos criteria.

i) Draw the configuration diagram. 2

ii) Calculate the total number of crosspoints. 2

iii) Find the possible number of simultaneous connections. 1

iv) Find the possible number of simultaneous connections if we use a single crossbar (100×100). 1

v) Find the blocking factor, the ratio of the number of connections in part iii) and in part iv). 1

c) What is TSI and what is its role in time-division switching? 3