B. CSE. ENGG. 3RD YR EXAMINATION, 2017

1st Semester

DIGITAL COMMUNICATION SYSTEM

Time : Three hours | Full Marks : 100

Answer any *five* questions.

1. What does the sampling theorem tell us concerning the rate of sampling required for an analog signal? Develop a state diagram (finite state machine) representation of pseudoternary coding. Draw the graph of the differential Manchester scheme using each of the following data streams, assuming that the last signal level has been positive. From the graphs, guess the bandwidth for this scheme using the average number of changes in the signal level.
   a. 00000000
   b. 11111111
   c. 01010101
   d. 00110011

   5+5+10=20

2. What does decibel measure mean? Define noise factor and noise figure. Given a receiver with an effective noise temperature of 294 K and a 10-MHz bandwidth, what is the thermal noise level at the receiver's output? A TV channel has a bandwidth of 6 MHz. If we send a digital signal using one channel, what are the data rates if we use one harmonic, three harmonics, and five harmonics? 2+3+5+5=20

3. Stale Nyquist theorem. What does the Shannon capacity have to do with communications? What key factors affect channel capacity? For binary phase-shift keying, E_b/N_0=8.4 dB is required for a bit error rate of 10^{-4} (one bit error out of every 10,000). If the effective noise temperature is 290°K (room temperature) and the data rate is 2400 bps, what received signal level is required? What is the theoretical capacity of a channel in each of the following cases:
   a. Bandwidth: 20 KHz SNRdB =40
   b. Bandwidth: 200 KHz SNRdB =4
   c. Bandwidth: 1 MHz SNRdB =20

   3+3+4+4+6=20

4. How are binary values represented in amplitude shift keying, and what is the limitation of this approach? Describe the constellation diagrams for an ASK (OOK), BPSK, and QPSK signals. How QPSK can be implemented? What SNR ratio is required to achieve a bandwidth efficiency of 1.0 for ASK, FSK, PSK, and QPSK? Assume that the required bit error rate is 10^{-6}. 2+5+5+8=20

5. Compare between Unshielded Versus Shielded Twisted-Pair Cable. What are the different propoagation modes in wireless propagation? What is the position of the transmission media in the OSI or the Internet model? What is the maximum distance between two antennas for LOS transmission if one antenna is 100 m high and the other is at ground level? Let the receiving antenna be 10 m high. To achieve the same distance, how high must the transmitting antenna

high noise

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be? How the loss varies with distance for microwave, twisted-pair and co-axial cable media.

3+4+3+(3+3)+4=20

6. Single sideband modulation may be viewed as a hybrid form of amplitude modulation and frequency modulation. Evaluate the envelop and instantaneous frequency of an SSB wave for the following two cases:

a. When only the upper sideband is transmitted.
b. When only the lower sideband is transmitted.

Describe the implementation of narrowband FM signal using a block diagram. Describe the discrete spectrum of the signal $s(t) = Re[A_c \exp(j2\pi f_c t + j\beta \sin(2\pi f_m t))]$. Determine the average power of this wideband signal, expressed as the percentage of the average power of the unmodulated carrier wave using Bessel coefficients. 3+3+4+(5+5)=20

7. a. Distinguish between synchronous and statistical TDM. Why is it that the start and stop bits can be eliminated when character interleaving is used in synchronous TDM? Ten 9600-bps lines are to be multiplexed using TDM. Ignoring overhead bits in the TDM frame, what is the total capacity required for synchronous TDM? Assuming that we wish to limit average TDM link utilization to 0.8, and assuming that each TDM link is busy 50% of the time, what is the capacity required for statistical TDM?

b. Can we share a bandwidth in DSSS as we do in FHSS? An FHSS system employs a total bandwidth of and an individual channel bandwidth of 100 Hz. What is the minimum number of PN bits required for each frequency hop? 3+2+(4+4)+2+5=20

8. a. Compare Forward Error Correction and Retransmission methods. Geometrically describe what should be the minimum Hamming distance to correct t errors. Which of the following CRC generators guarantee the detection of a single bit error?

a. x3 + x + 1
b. x4 + xl
c. 1
d. x2 + 1

b. Using the CRC-CCITT polynomial, generate the 16-bit CRC code for a message consisting of a 1 followed by 15 0s.

a. Use long division.
b. Use the shift register mechanism. 2+4+6+(4+4)=20

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