**CS 31006: Computer Networks (Theory)**

**Spring 2016: Mid-Semester Examination**

**Time: 2 hours Marks: 60**

**Question 1**

Answer the following questions briefly: [1 x 10 = 10]

1. State the different types of noise.
2. In the OSI reference model, which layers are end-to-end?
3. What key factors affect channel capacity?
4. A signal has a fundamental frequency of 1000 Hz. What is its period?
5. Name two multilevel binary digital-to-digital encoding techniques.
6. State the difference between QPSK and offset QPSK?
7. What is piggybacking?
8. How does differential Manchester encoding differ from Manchester encoding?
9. Define bit length of a link.
10. Name all the variations of the Automatic Repeat Request error control mechanisms.

**Question 2**

Answer the following questions briefly. Draw neat diagrams wherever applicable. [2 x 5 = 10]

1. Is it possible to design an ECC that will correct some double bit errors but not all double bit errors? Why or why not?
2. Explain briefly, with diagrams, the relation between bit rate and symbol (baud) rate.
3. Why are CRC polynomials chosen to retain the x0 term? Justify.
4. What are the (i) exposed station and (ii) hidden station problems in 802.11 Ethernet MAC sublayer protocol?
5. What should be the minimum Hamming distance between any two codewords to correct bit-errors of up to 4 bits? Justify.

**Question 3**

Answer the following questions:

1. How can data rate be increased while using the same bandwidth? [1]
2. Calculate the total time required to transfer a 1.5-MB file in the following cases, assuming an RTT of 80ms, a packet size of 1 KB data, and an initial 2×RTT of “handshaking” before data is sent:
3. The bandwidth is 10 Mbps, and data packets can be sent continuously. [2]
4. The bandwidth is 10 Mbps, but after we finish sending each data packet we must wait one RTT before sending the next. [2]
5. The link allows infinitely fast transmit, but limits bandwidth such that only 20 packets can be sent per RTT. [2]
6. Zero transmit time as in (c), but during the first RTT we can send one packet, during the second RTT we can send two packets, during the third we can send four (23−1), etc. [3]

**Question 4**

Answer the following questions:

1. With an example, explain the B8ZS encoding scheme. [2]
2. State the differences between the working of a hub, a bridge, and a switch. [3]
3. Describe the working of the CSMA/CD protocol with binary exponential back-off mechanism. [3]
4. A channel has a bit rate of 4 kbps and a propagation delay of 20 msec. For what range of frame sizes does stop-and-wait give an efficiency of at least 50%? [2]

**Question 5**

Answer the following questions:

1. Suppose a 128-kbps point-to-point link is set up between the Earth and a rover on Mars. The distance from the Earth to Mars (when they are closest together) is approximately 55 Gm, and data travels over the link at the speed of light—3×108 m/s.
2. Calculate the minimum RTT for the link. [1.5]
3. Calculate the delay × bandwidth product for the link. [1.5]
4. A camera on the rover takes pictures of its surroundings and sends these to Earth. How quickly after a picture is taken can it reach Mission Control on Earth? Assume that each image is 5Mb in size. [3]
5. A typical telephone subscriber loop has a usable audio bandwidth of 0-4000 Hz. Voice samples for digital transmission using a modem are represented in 8 bits. What is the bit rate required for the digital transport of voice? What is the permissible S/N ratio to support this bit-rate? [2+2]

**Question 6**

Answer the following questions:

1. A block of bits with n rows and k columns uses horizontal and vertical parity bits for error detection. Suppose that exactly 4 bits are inverted due to transmission errors. Derive an expression for the probability that the error will be undetected. [3]
2. State and illustrate the principle of video interlacing scanning. Given that there are 483 lines in a TV screen, assume 30 scans per second, and width to height ratio of the TV screen as 4:3. What is the bandwidth of the video signal needed? [2+2]
3. Represent the signal 00110100010 using ASK, BFSK, and BPSK. [3]