ECEN4533 Exam #2 11 April 2011

1) A 47 byte ACKnowledgement is transmitted over a network with a P(Bit Error) = 0.002. At the receiver, a Layer 2 CRC will reject packets with any bits in error.
1a [15] **Compute** the probability an ACK is not received due to a bit error. [Answer = 0.5289]
1b [10] Suppose a design goal is that the P(ACK is error free at the receiver) needs to be at least 0.99. What is the allowable P(Bit Error)? [$26.73*10^{-6}$]

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2) Suppose a variable bit rate HDTV video coder generates an average of 79,000 B every 1/30th second, and that this video is to be transmitted over an Ethernet with a maximum segment size of 1460 bytes.
2a [10] **Compute** the average Ethernet frame size. Note Ethernet requires 66 bytes of overhead. [12,019 bits]
2b [5] **Compute** the average bit rate that must be carried by the Ethernet LAN. [19.83 Mbps]
2c [10] If this traffic is self-similar with an H parameter of 0.86 and is being carried on a 100 Mbps Ethernet link, **compute** the average amount of time a packet would spend in a switch. [7.297 µsec]

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3) A network is using TCP, IPv4, and Ethernet with a TCP maximum segment size of 1460 bytes. A compressed video application is passing 1080 byte segments to TCP 84% of the time, and 2490 byte segments to TCP 16% of the time.
[25] **Compute** the percentage of the resulting Ethernet traffic that is video. [94.46%]

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4) A large file is being transmitted back-to-back over an 840 Kbps connection (i.e. there are no queues) with an end-to-end propagation delay of 0.2 msec and a receiver that issues ACK's 800 µsec after receiving a complete packet. TCP is being used with a 91,200 B window and 480 byte TCP segments. 27 more bytes (IPv4 & PPP) are added prior to transmission, meaning 507 byte frames are transmitted over the network. Assume TCP has exited Slow Start and is now in normal operation, and that an ACK is generated for each successfully received packet.
4a [15] **Compute** the time that will elapse between the leading edge of a specific packet being transmitted and the trailing edge of its ACK being received, assuming error free transmission. [6.476 msec]
4b [10] Suppose packet N is received successfully but the ACK associated with this segment never arrives at the transmitter's TCP layer. Assuming error free operation otherwise, **compute** the minimum value required of the TCP Retransmission Timer that will prevent a time-out from occurring at the

transmitter. Assume the time out timer starts when the leading edge of packet N is transmitted and stops when the trailing edge of an ACK for packet N is received. [11.31 msec]