

*Department of Electrical Engineering*

**EC-305 : Communication Systems**

Nov.9, 2009

**Mini-Quiz #3**

10 Marks

1. [3 marks] In a certain digital multiplexer, 3 input streams arrive with rates and clock ppm given as follows: 5Mbps (2ppm), 2Mbps (3ppm), and 1Mbps (5ppm). If a 32-bit frame header and a 16-bit CRC are added to every 200msec frame assembled by this multiplexer along with appropriate stuff-bits (and indicators), answer the following:

- (a) Make a rough sketch of the assembled frame, indicating the various important fields.
- (b) What is the output bit-rate?

2. [7 marks] A 20 MHz signal is to be wirelessly transmitted over a distance of 10.10km, where the channel has a path loss exponent of  $n=2$ . Repeaters are to be used to make this possible where both the Tx and Rx antennas have a gain of 23dBi each, the loss 1meter away from the antenna is  $L_{1m}=36\text{dB}$ . Assume that the thermal noise PSD is  $-174\text{dBm/Hz}$ . Two choices of the power amplifier (used in each repeater) are possible:

- (i) Choice-1: Gain  $A=30\text{dB}$ , and noise figure  $F=4\text{dB}$
- (ii) Choice-2: Gain  $A=40\text{dB}$ , and noise figure  $F=8\text{dB}$

Assuming a system with  $N+1$  hops, the required SNR at the output of the  $N^{\text{th}}$  amplifier is  $\text{SNR}_0=18\text{dB}$ . The regulatory specification does not allow the transmit power  $P_T$  to exceed  $-30\text{dBm}$  (1microwatt) in any of repeaters. Which of the above 2 choices will then be preferred? Specify the number of hops and the  $P_T$  that will be used in each case.