Problems for the 9th Quiz

Name:________________ Student ID:________________ Score:______________

1. Suppose the M12 multiplexer has been **remodeled** such that 24 control bits are separated by sequences of **24** data bits (**6** from each DS1 input). The frame format is given below.

M_0	24	C_I	24	F_0	24	C_I	24	C_I	24	F_1	24
M_1	24	C_{II}	24	F_0	24	C_{II}	24	C_{II}	24	F_1	24
M_1	24	C_{III}	24	F_0	24	C_{III}	24	C_{III}	24	F_1	24
M_1	24	C_{IV}	24	F_0	24	C_{IV}	24	C_{IV}	24	F_1	24
Subframe markers		Stuffing indicators		Frame markers		Stuffing indicators		Stuffing indicators		Frame markers	

(a) Suppose only **143** data bits arrive from DS1#1 within a duration of a DS2 frame, but DS1#2, DS1#3 and DS1#4 do have **144** data bits available in their input buffers. Give the value of C_{I}.

(b) Let the nominal output bit rate be **6** Mbps. Determine the *largest incoming bit rate* $f_{\text{in,max}}$ allowed for each DS1 in the system.

Hint: Now the frame contains only **600** $= 24 \times 24 + 24$ bits (instead of **1176** bits); so you must modify the below equation:

$$\frac{288}{f_{\text{in}}} \geq \frac{1176}{f_{\text{out,nominal}}} \geq \frac{287}{f_{\text{in}}}$$

(c) Let the nominal output bit rate be **6** Mbps. Determine the *smallest incoming bit rate* $f_{\text{in,min}}$ allowed for each DS1 in the system.

(d) The allowable tolerance range for DS1 inputs in terms of ppm with respect to $f_{\text{in,nominal}} = \frac{1{,}000}{696} \approx 1.43678$ Mbps can be computed via

$$\frac{10^6 - b_{ppm}}{f_{\text{in,min}}} = \frac{10^6}{f_{\text{in,nominal}}} = \frac{10^6 + a_{ppm}}{f_{\text{in,max}}} \Leftrightarrow a_{ppm} + b_{ppm} = 10^6 \left(\frac{f_{\text{in,max}} - f_{\text{in,min}}}{f_{\text{in,nominal}}} \right)$$

Suppose that over a particular cable, decreasing one degree on the Fahrenheit scale will result in approximately 100 ppm variation. Find the range of temperature variation allowable for this cable.

Solution.

(a) $C_{\text{I}} = 1$

(b)&(c) During the time period for the M12 multiplexer to send out 600 bits, each DS1 input must provide at least 143 bits and at most 144 bits; hence,

$$\frac{144}{f_{\text{in}}} \geq \frac{600}{6} \geq \frac{143}{f_{\text{in}}}$$

which implies

$$f_{\text{in,max}} = 1.44 = \frac{144}{600} \cdot 6 \geq f_{\text{in}} \geq \frac{143}{600} \cdot 6 = 1.43 = f_{\text{in,min}}.$$

(d)

$$a_{ppm} + b_{ppm} = 10^6 \left(\frac{f_{\text{in,max}} - f_{\text{in,min}}}{f_{\text{in,nominal}}} \right) = 10^6 \left(\frac{\frac{6}{600}}{\frac{1000}{696}} \right) = 6960 \text{ ppm}$$

which implies

$$\frac{a_{ppm} + b_{ppm}}{100} = 69.6 \text{ degrees on the Fahrenheit scale}$$