

1) In a 6 Mbps baseband binary transmission system, a Logic 1 is represented by a +1.3 volt pulse and a Logic 0 by a -1.3 volt pulse. The system is contaminated by additive white noise $n(t)$ with voltage probability density function $f_N(n) = 4.0e^{-8.0|n|}$.

[25] **Compute** the P(Bit Error) for a single sample MAP detector. [Answer = 15.22×10^{-6}]

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2) A signal $s(t) = 1,000\sin(1,000\pi t)/(1,000\pi t)$ is transmitted through a filter having a transfer function $H(f) = 1 - |f|/1,000; |f| \leq 1,000$ Hz. $H(f) = 0$ otherwise. The filter output $y(t)$ is then ideally sampled at a sampling rate of $f_s = 1,000$ samples/second.

[25] **Sketch** the voltage spectrum of the sampled signal. [You should sketch triangles riding on top of a constant value of 500 volts/Hertz. The triangles should be 500 volts/Hertz high with a width of 1000 Hertz. The triangles should be centered on 0 Hertz and all positive and negative integer multiples of the sampling frequency of 1000 Hertz.]

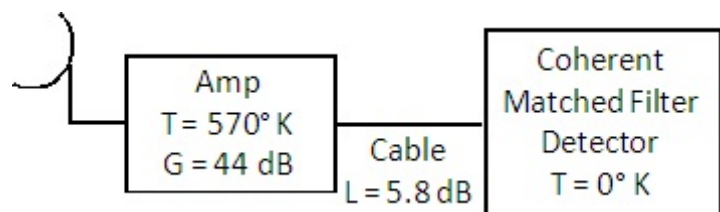
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3) A 10 Mbps On-Off ASK optical fiber link is in operation. A break occurs in the fiber, and the splice made to repair the break results in an attenuation of 2.2 dB to the received power. Typical received symbols for the system at the photo detector output prior to the break were $s_1(t) = 0.013; 0 \leq t \leq T$ and $s_0(t) = 0.0; 0 \leq t \leq T$.

[25] **Determine** typical received signals at the photo detector output after the break is repaired. [$s_1(t) = 0.01009; 0 \leq t \leq T$ and $s_0(t) = 0.0; 0 \leq t \leq T$]

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4) A spacecraft located 65,000 km from Earth is sending data via anti-podal BPSK at a rate of R bps. The signal center frequency is 2.0 GHz and the transmitted power is 2 watts. The spacecraft antenna gain is 9 dB. The Earth station uses a 6 meter diameter parabolic antenna with an efficiency of 57% and an antenna temperature of 110 degrees Kelvin. Other losses total 1.4 dB. FEC is not used.



[25] Given the block diagram of the receiver system shown, **Compute** the maximum bit rate R that can be used if the maximum allowable P(Bit Error) is 0.0017. [R = 49.38 dB = 86,756 bps]