Solutions Homework #8
Introduction to Communication Systems – E3701

Problem 1:

From class notes we know that

$$E_b = \int_{-\infty}^{\infty} \left|\sqrt{H(f)}\right|^2 df = 2W$$

$$N_{out} = \int P_y(f)df = \int |H(f)|^2 P_x(f)df = \int_{-\infty}^{\infty} \left|\sqrt{H(f)}\right|^2 \frac{N_0}{2} df = 2W\frac{N_0}{2}$$

where $P_x(f)$ and $P_y(f)$ are the power spectral densities of the input and output, respectively.

We are using raised cosine filtering so our H(f) signal looks identical to the one from problem 1 of homework 7. When we transformed this to the time domain we saw that it was essentially a sinc function. When we sample at the output of the receiver we are sampling at time t = 0. When t = 0 our sinc function reaches its maximum height of 2W. Signal power is thus

$$S = V_{out}{}^2 = (2W)^2$$

$$\frac{S}{N_{out}} = \frac{V_{out}{}^2}{N_{out}} = \frac{(2W)^2}{2WN_0/2} = \frac{2(2W)}{N_0} = \frac{2E_b}{N_0}$$