UNIVERSITY OF THE WEST INDIES
CAVE HILL CAMPUS

Department of Computer Science, Mathematics & Physics

ELET2230 - Digital Communications 1

Assignment 2 **Due: December 5, 2020**

1. If a transmitted BPSK signal $s_1(t) = cos(20\pi t)$ is of duration 0.5 seconds determine:
   (a) The amplitude of the signal and it's carrier frequency. [3]
   (b) Energy per binary digit E_b [2]
   (c) Coordinates of the signal points at the receiver under a noiseless channel [2]

2. Given that BPSK signals are $s_1(t) = \sqrt{E_b} \cdot \phi_1(t)$ and $s_2(t) = -\sqrt{E_b} \cdot \phi_1(t)$, where $\phi_1 = \sqrt{\frac{2}{T_b}} cos(2\pi f_c t)$,
   Derive the following expression for the probability of an error in a binary digit $P_b = Q\left(\sqrt{\frac{2E_b}{N_o}}\right)$, where E_b is the energy per binary digit, N_o is the single sided noise spectral power density, T_b is the symbol duration and f_c is the carrier frequency. [8]

   Hence show that if the BPSK modulator is replaced by a QPSK modulator , then P_b for QPSK is given by $\left(\alpha - \frac{\alpha^2}{2}\right)$ [5]

3. Consider a BPSK demodulator that utilizes an 8-level soft-decision output. Derive an expression for the forward transition probability $P(4|0)$ [8]

   Explain how one could determine this forward transition probability P(4|0) by simulation [2]