EE161 — Spring 2025 **San José State University**
Homework # 4 **Due: Thu. 2/27/25**

1. In the same figure, plot the average bit error probability P_b as a function of the signal energy-to-noise ratio E_s/N_0 (dB), using the nearest-neighbor approximation (NNA), of M-ary PPM (orthogonal modulation) for $M = 2, 4$ and 16

   (a) Compare M-PPM with M-ary QAM for the same values of M. Which scheme is better (for the same P_b value) and by how much?

   (b) Discuss the main disadvantage of M-PPM with respect to M-QAM for the same symbol duration T

2. Compare the error performances of 16-PAM, 16-PSK and 16-QAM as follows.

   (a) In the same figure, plot P_b of each scheme using the NNA derived in class

   (b) Which scheme is better?

   (c) Determine the required E_s/N_0 (dB) to achieve $P_b = 10^{-2}$