1. Derive the psd of $M$-ary PSK.

2. Sketch BER vs. SNR plots for $M$-ary FSK for the cases of $K = 1, 2, 3, 4, 5$ where $K = \log_2 M$.

3. An $M$-QAM system can thought of as two PAM systems in quadrature, each having $\sqrt{M} = 2^m$ constellation points and one-half the power of the QAM system. Show that the probability of error for such a $\sqrt{M}$-PAM system is

$$P_{\sqrt{M}} = 2(1 - \frac{1}{\sqrt{M}})Q\left(\sqrt{\frac{6}{M - 1}} \frac{\gamma_s}{2}\right),$$

where $\gamma_s$ is the average received symbol energy-to-noise ratio for the $M$-QAM signal constellation.

4. The squared euclidean distance between a pair of CPM bandpass waveforms $s(t; x^{(i)})$ and $s(t; x^{(j)})$ is given as

$$D^2 = \int_0^{\infty} [s(t; x^{(i)}) - s(t; x^{(j)})]^2 dt$$

Show that

$$D^2 = 2\log_2 ME_b \frac{1}{T} \int_0^{\infty} (1 - \cos(\Delta \phi(t))) dt$$

where $M$ is the symbol alphabet size, $E_b$ is the energy per bit and $\Delta \phi(t)$ is the phase difference between the two signals.