1. (15%) Graph the given function, which is assumed to be zero outside the given interval. Find its Laplace Transform. (show the details of your work.)

$$f(t) = t^2, \ 0 < t < 3.$$

2. (15%) Show that the following functions form an orthogonal set; and show its corresponding orthonormal set:

$$y_m(x) = \cos mx, \ m = 0,1,2,3,\ldots; \text{ on the interval } -\pi \le x \le \pi.$$

3. Let $A = \begin{bmatrix} 1 & 3 & 3 \\ -3 & -5 & -3 \\ 3 & 3 & 1 \end{bmatrix}$ and $B = A^{10}$.

   (20%) a. Compute B.
   (10%) b. Find the eigenvalues of B.

4. (10%) For a signal $f(x)$ with a period P, i.e., $f(x) = f(x + P)$, please find its Fourier series representation. The signal $f(x)$ is shown as follows:

$$f(x) = 2 - 3x^2 \text{ with } -1 < x < 1 \ (P=2).$$

5. (15%) Find all values of $\sin^{-1} 5$.

6. (15%) Evaluate the Cauchy principle value of

$$\int_{-\infty}^{\infty} \frac{\sin x}{(x+1)(x^2 - 2x + 1)} dx.$$