I. Plotting Graph Signals:

1. Define a signal $x \in$ on a graph G, which is characterized by the adjacency matrix A. Where $A = \begin{pmatrix} 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{pmatrix}$ and $x = \begin{pmatrix} 1 \\ -1 \\ -1 \\ 1 \\ 1 \end{pmatrix}$. Now create a MATLAB function to plot this 2D graph signal.

2. Generalize the above code and define an arbitrary signal (generate a random sequence of particular range) on the graph plotted in Bucky ball example.

II. GFT Synthesis and Analysis:

3. Compute GFT X^G, of a graph signal x, defined on a graph G in question 1. Let the eigenvector matrix is U, then,

$$X^G = U^H x.$$

And compute the inverse transformation from the coefficients using

$$x = UX^G.$$

Write and verify the property of eigenvector matrix (U).Repeat question 3 for the following signals defined on the graph in Bucky ball example

a) $x_1 = 3 * U(:,1) + 10 * U(:,15) + 2 * U(:,32);$

b) $x_2 = k_1 * U(:,60)$; Where $k_1 = 5$.

c) $x_3 = k_2 * U(:,1)$; Where $k_2 = 2$.

d) x_4 = arbitrary random signal (uniform random sequence) of length 60

4. Calculate the sparsity order for GFT coefficient vectors of the above signals.