I. Parseval's Relation (conservation of Energy):

1. Consider the signal $x_1(n)$, defined on Minnesota graph G, whose GFT coefficients are $X_1^G(l) = e^{-100\lambda_l}$. Now verify the Parseval's relation.

2. Now consider another signal $x_2(n)$, defined on Minnesota graph G, whose GFT coefficients are $X_2^G(l) = Ce^{-100\lambda_l}$. Now choose the value C such that $\left|\left|x_2\right|\right|_2 = 1$.

II. Translation:

3. Plot the signals $x_1(n)$ and $x_2(n)$, defined on a graph G (Minnesota graph) having GFT coefficients as given below,

$$X_1^G(l) = Ce^{-5\lambda_l} : \left|\left|\mathrm{x}_1\right|\right| = 1$$

$$X_2^G = 3e^{-\lambda_l} + k_1 e^{-3\lambda_l} : \left|\left|\mathrm{x}_2\right|\right| = 2$$

Now perform the following translation operation on $x_1(n)$ and$x_2(n)$, then plot the translated signals on graph G.

a. $T_{200}x_1$ (where T is a translational operator)
b. $T_{1000}x_1$
c. $T_{2000}x_1$
d.
d. $T_{2000}x_2$
e. $T_{1500}x_2$

Note: For more information refer to paper on "Windowed GFT" uploaded on blackboard.

III. Modulation:

4. Compute and plot the graph spectral representation of signal $x_2(n)$ defined in question 2.

    a. Now modulation of the signal $x_2(n)$ is defined by modulation operator M_k and is represented as $(M_k x_2)(n)$.

    b. Then plot the graph spectral representation of modulated signal $(M_k x_2)(n)$ with $k = 2000,100$ and 2642. Here in the plotting the x-axis represents the eigenvalues (not eigenvalue index) and y-axis represents the $X_2^G(l)$.

Note: For more information refer to paper on "Windowed GFT" uploaded on blackboard.

IV. Graph Signal Compression:

5.Construct smooth signal$x_1\hat{}(n)$ of the signal defined in Question No .1, by choosing only First 'M' non zero values of GFT coefficients of it. Calculate the distortion (Squared error between original and approximated signal) introduced by this operation. Finally plot a graph by varying M on x- axis and corresponding distortion in y-axis.