I.　Vertex-Frequency representation:

1. Consider an unweighted path graph of 180 vertices:

a. Now compose the signal $x(n)$ on the path graph by summing three signals: u_{10} restricted to the first 60 vertices, u_{60} restricted to the next 60 vertices, and u_{30} restricted to the final 60 vertices. Now plot the composed signal on the path graph (Here consider the coordinates of the path graph such a way that, the graph should look like a path).

b. Now design a window $w(n)$ with the GFT coefficients as given below,

$$W^G(\lambda_l) = Ce^{-300\lambda_l} : |W^G| = 1$$

c. Now plot the spectrogram of the graph $|sx(i,k)|^2$, where
$$sx(i,k) = <x, w_{i,k}> \text{ and}$$
$$w_{i,k}(n) = (M_k T_i w)(n) = Nu_k(n) \sum_{l=0}^{N-1} W^G(\lambda_l) u_l(i) u_l(n).$$