**Supplementary Material-6: Mathematical Model of GCN used in Proposed BDL-SP Model**

An undirected graph 𝓖 = (𝓥, 𝓔) is a collection of a finite set of nodes 𝓥 and a finite set of edges 𝓔. The nodes in the graph represent the significantly altered genes, and the edges represent the interaction between them. The feature vector having 28 genomic features at each node corresponds to the genomic profiles of each significantly altered gene. In the spectral GCN, the graph connectedness is represented by a graph Laplacian that uses node degree and adjacency information. The normalized graph Laplacian (also called normalized symmetric adjacency matrix) can be defined as

where is the degree matrix such that and  where is the adjacency matrix that can be written as

The normalized graph Laplacian is a positive semi- definite matrix that can be decomposed  using eigenvalue decomposition as

where is the eigenvector of graph Laplacian and is a diagonal matrix having eigenvalues in its diagonal. The convolutional filters in spectral GCNs exploit the principles of Fourier and Laplace transform while scanning over a signal in n-dimensional non-Euclidean space. The convolution operation in the Fourier domain is defined by computing the eigen decomposition of the graph Laplacian. The graph signal represents the feature vector of all the nodes in the graph, expressed by

. The Fourier transform of the graph signal is given below:

The spectral convolution in between the graph signal and the filter can be written as

where represent the function of eigenvalues of graph Laplacian , represent the graph Fourier transform of signal [42]. The computational complexity of the above convolution model is relatively high, which is . In order to reduce the computational complexity of this model, the graph signal convolution can be computed by approximating  Chebyshev polynomials and using renormalization trick mentioned in [42] as

With the simplified model as mentioned above, the simplified spectral GCN model as mentioned in [42] is

We have used a two layer spectral GCN model in the proposed BDL-SP architecture.