Signed and directed networks are ubiquitous in real-world applications. However, there has been relatively little work proposing spectral graph neural networks (GNNs) for such networks. Here we introduce a signed directed Laplacian matrix, which we call the magnetic signed Laplacian, as a natural generalization of both the signed Laplacian on signed graphs and the magnetic Laplacian on directed graphs. We then use this matrix to construct a novel efficient spectral GNN architecture and conduct extensive experiments on both node clustering and link prediction tasks. In these experiments, we consider tasks related to signed information, tasks related to directional information, and tasks related to both signed and directional information. We demonstrate that our proposed spectral GNN is effective for incorporating both signed and directional information, and attains leading performance on a wide range of data sets. Additionally, we provide a novel synthetic network model, which we refer to as the Signed Directed Stochastic Block Model, and a number of novel real-world data sets based on lead-lag relationships in financial time series.