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Graphic Matrices Over a Group

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Graphic matrices are such as the adjacency matrix, the incidence matrices, the Kirkhhoff (or Laplacian) matrix, and the adjacency matrix of the line graph. Each of them has integral entries. There are integral matrices of a signed graph (a graph with signed edges) that directly generalize the graphic matrices. I will consider a different generalization: the entries of the matrices belong to the group ring of the sign group. This type of matrix has interesting new properties and generalizes even further, to matrices of a gain graph, where the edges are labelled (orientably) from any group G, with the elements of the matrix belonging to the group ring **Z**G or, for another example, the complex group algebra **C**G.
