IPM Combinatorics II: Design Theory, Graph Theory, and Computational Methods
April 22-27, 2006, IPM, Tehran

Commuting Decompositions of Complete Bipartite Graphs

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We say that two graphs G and H with the same vertex set commute if their adjacency matrices commute. In this paper we show that if n is a natural number, then the complete bipartite graph $K_{n,n}$ is decomposable into commuting perfect matchings if and only if n is a 2-power. Also it is shown that the complete bipartite graph $K_{n,n}$ has a commuting quasi-Hamilton decomposition if and only if n is a prime number. Finally we prove that for even number n, $K_{n,n}$ is decomposable into commuting Hamilton cycles if and only if n is 2-power.