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Symmetric graphs and interconnection networks

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Abstract

An interconnection network is usually modelled by an undirected graph in which vertices represent processors or memory modules, and edges represent communication links. It is known that the symmetric properties of a graph (such as the vertex regularity, vertex transitivity, edge transitivity, arc transitivity) are the better parameters to measure the stability and synchronizability of an interconnection network. In this paper, we study a subclass of pentavalent symmetric graphs of cube-free order, that is, the case of order $36p$, where p is a prime. A complete classification is given of such graphs. As a byproduct, the classification result includes a non-quasiprimitive graph admitting a quasiprimitive 2-arc-transitive group action. To our knowledge, this is the first known example in pentavalent 2-arc-transitive graphs.

Keywords: Symmetric graph, Interconnection network, Normal quotient, Automorphism group

1. Introduction

There are several graph parameters of the reliability and vulnerability of an interconnection network, such as connectivity, scattering number, integrity, tenacity, vertex regularity, vertex transitivity, edge transitivity and arc transitivity. Among these parameters, the scattering number, integrity, tenacity are the better ones to measure the stability of a network, see [24] for example. And a vertex regular graph is a Cayley graph (see [2, Proposition 16.3]). Such graphs can be used as models for interconnection networks because of the many advantages that they exhibit, see the survey paper [17]. Furthermore, among the graphs with high levels of symmetry, vertex-transitive, edge-transitive or arc-transitive graphs are widely used in the design of interconnection networks. For example, a number of interconnection networks of both theoretical and practical importance, including hypercubes, alternating group graphs, star graphs and some of their generalisations are both vertex transitive and edge-transitive. We refer the