

First Integrals and Phase Portraits of Planar Polynomial Differential Cubic Systems with the Maximum Number of Invariant Straight Lines

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Abstract In the article Llibre and Vulpe (Rocky Mt J Math 38:1301–1373, 2006) the family of cubic polynomial differential systems possessing invariant straight lines of total multiplicity 9 was considered and 23 such classes of systems were detected. We recall that 9 invariant straight lines taking into account their multiplicities is the maximum number of straight lines that a cubic polynomial differential systems can have if this number is finite. Here we complete the classification given in Llibre and Vulpe (Rocky Mt J Math 38:1301–1373, 2006) by adding a new class of such cubic systems and for each one of these 24 such classes we perform the corresponding first integral as well as its phase portrait. Moreover we present necessary and sufficient affine invariant conditions for the realization of each one of the detected classes of cubic systems with maximum number of invariant straight lines when this number is finite.

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