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# Integrable Time-Dependent Dynamical Systems: Generalized Ermakov-Pinney and Emden-Fowler Equations

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**Abstract:** We consider the integrable time-dependent classical dynamics studied by Bartuccelli and Gentile (Phys Letts. **A307** (2003) 274–280; Appl. Math. Lett. **26** (2013) 1026–1030) and show its power to compute the first integrals of the (generalized) Ermakov-Pinney systems. A two component generalization of the Bartuccelli-Gentile equation is also given and its connection to Ermakov-Ray-Reid system and coupled Milne-Pinney equation has been illucidated. Finally, we demonstrate its application in other integrable ODEs, in particular, using the spirit of Bartuccelli-Gentile algorithm we compute the first integrals of the Emden-Fowler and describe the Lane-Emden type equations. A number of examples are given to illustrate the procedure.

**Keywords:** *time-dependent harmonic oscillator; Ermakov-Pinney equation; first integrals; Ermakov-Lewis invariant; Emden-Fowler equation.*

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