

Systems of Ordinary Differential Equations > Nonlinear Systems of Two Equations

16.
$$x_{tt}'' + x^{-3}f(y/x) = x\Phi(x,y,t,x_t',y_t'), \quad y_{tt}'' + y^{-3}g(y/x) = y\Phi(x,y,t,x_t',y_t').$$
 First integral:

$$\frac{1}{2}(xy_t'-yx_t')^2 + \int^{y/x} \left[u^{-3}g(u)-uf(u)\right]du = C,$$

where C is an arbitrary constant.

Remark. The function Φ can also depend on the second and higher derivatives with respect to t

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http://eqworld.ipmnet.ru/en/solutions/sysode/sode0316.pdf