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About integration of the Chazy differential equation with six constant poles

We consider nonlinear differential equation of the third order with six constant coefficients a_k $(k = \overline{1,6})$ [1, 2]

$$u''' = \sum_{k=1}^{6} \frac{u'u'' + A_k u'^3 + B_k u'^2 + C_k u'}{u - a_k} + Du'' + Eu' + \prod_{k=1}^{6}(u - a_k) \sum_{i=1}^{6} \frac{F_k}{u - a_k}, \qquad (1)$$

where $u = u(z)$ is an unknown function; 32 coefficients of equation (1) $A_k, B_k, C_k, F_k, D, E, a_k$ $(k = \overline{1,6})$ satisfy the algebraic-differential system of the 31 equations [1, 2]. We determine coefficients A_k $(k = \overline{1,6})$ according to the formulas given in works [3, 4].

We find integration conditions of the equation (1) using the method of investigating equation (1) given in monograph [5].

For example, differential equation

$$u''' = \frac{u'u'' - \frac{7}{10}u'^3}{u-1} + \frac{u'u'' - \frac{1}{2}u'^3}{u-2} + \frac{u'u'' - \frac{13}{40}u'^3}{u-4} + $$
$$+ \frac{u'u'' + \frac{13}{40}u'^3}{u+4} + \frac{u'u'' + \frac{1}{2}u'^3}{u+2} + \frac{u'u'' + \frac{7}{10}u'^3}{u+1}$$

has general integral

$$\int \frac{du}{\sqrt{C_1 u(u^2+4) + C_2(u^4 + 33u^2 + 16)}} = z + C_3,$$

where C_1, C_2, C_3—are arbitrary constants.

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