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Solving Two–Dimensional Lane–Emden System Equations by MDTM

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Abstract: In this paper, we introduce and solve the nonlinear forms of two-dimensional Lane–Emden system equations. Using the properties of a Modified Differential Transform Method, we obtain exact analytical solutions for these equations without resorting to linearization, discretization, or perturbation, while requiring minimal computation.

Keywords: *two–dimensional Lane–Emden system equations; reduced differential transform method; modified differential transform method; initial value problems.*

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1 Introduction of Lane-Emden System Equations

The linear and nonlinear two–dimensional Lane–Emden type equations were first introduced by Wazwaz, Rach and Duan in [1], as follows:

$$u_{xx} + \frac{\propto}{x} u_x + u_{yy} + \frac{\beta}{y} u_y + g(x,y) f(u) = 0, \tag{1}$$

$$x > 0, \qquad y > 0, \qquad \propto > 0, \qquad \beta > 0,$$

$$u(x,0) = h(x), \quad u_y(x,0) = 0, \quad u(0,y) = h(y), \quad u_x(0,y) = 0, \tag{2}$$

where $g(x,y) f(u)$ is a linear or nonlinear term.

In [2], N. Teyar introduced the linear and nonlinear two–dimensional Lane–Emden system equations

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