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Properties of MDTM and RDTM for Nonlinear Two-Dimensional Lane-Emden Equations

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Abstract: In this paper, we study the linear and the nonlinear forms of two–dimensional Lane–Emden type equations by proving and applying new product and quotient properties for different differential transform methods (RDTM and MDTM), in order to minimize computation to the maximum. We will obtain exact analytic solutions without linearization, discretization or perturbation, even with less computation.

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

Mathematics Subject Classification (2010): 35J15, 35J47, 70F15, 35J75. 70K99.

1 Introduction

The linear and nonlinear two-dimensional Lane-Emden type equations are first introduced by Wazwaz, Rach and Duan in [8], as follows:

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

$$x > 0,\ y > 0,\quad \alpha > 0,\ \beta > 0,$$

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

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

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