Solitary Wave-Type Solutions of Nonlinear Diffusion Reaction Equation Using Auxiliary Equation Method

Ram Mehar Singh, S.B. Bhardwaj, Fakir Chand and Anand Malik *

With a view to exploring the new vistas regarding the nonlinear diffusion reaction equations and following the prescription of Zhao et al. [1] for the solution of KdV equation, we have investigated the solitary wave-type solutions of the nonlinear diffusion reaction equations involving the higher order nonlinearities. For this purpose, the symbolic computation technique and auxiliary equation method are employed. It can be seen that, convective term coefficients can be any arbitrary function of time which affect the velocity of the wave whereas reaction coefficient affects the amplitude of wave. The variable coefficients help to control the characteristics of the obtained solitary wave type solution of nonlinear diffusion reaction equations.

The diffusion reaction equations have attracted the special attention role not in physical but also in biological and social sciences [2]. Solutions of these equations play an important role in the qualitative description of many phenomena like heat conduction in plasma, population genetics and liquid evaporation etc. The variable coefficient nonlinear diffusion reaction equation has grown slowly because most of the nonlinear equation possesses variable coefficients [3,4,5]. The dimensionless form of the variable coefficient nonlinear diffusion reaction equation is

$$C_t + v(t)C^m C_x = DC_{xx} + \alpha(t)C - \beta(t)C^n, \qquad (1)$$

where, C=C(x,t) is the concentration or density variable depending upon the phenomena under study, D - diffusion coefficient, v- convection term coefficient, α and β are reaction term coefficients, m and n are positive integers such that $n \geq 2$. There are different method to solve the nonlinear diffusion reaction equation but we have used auxiliary equation method to find the solitary wave-type solutions of (1) for different value of m and n.

Fresh research work is reported in the paper and it is not published anywhere.

References

[1] X. Zhao, D. Tang and L. Wang. New soliton- like solutions for KdV equation with variable coefficient. *Phys. Lett. A*, 346: 288-291, 2005.

[2] Sirendaoreji A. New auxiliary equation and exact traveling wave solutions of nonlinear equation. *Phys. Lett. A*, 356: 124-130, 2006.

[3] E. Yomb. Construction of new soliton-like solutions for the (2+1)dimensional KdV equation with variable coefficients. *Chaos Solitons Fractals*, 21: 75-79, 2004.

[4] R. Kumar, R. S. Kaushal and A. Prasad. Soliton like solutions of certain types of nonlinear diffusion-reaction equation with variable coefficients. *Phys. Lett. A*, 372: 1862-1866, 2008.

[5] V. K. Sharma, A. Goyal, T. S. Raju and C. N. Kumar. Periodic and solitary wave solutions for ultra short pulses in negative index materials. *J. Mod. opt.*, 60(10): 836-840 2013.

*Ram Mehar Singh is with the Department of Physics, Ch. Devi Lal University, Sirsa-125055, India, email: $dixit\_rammehar@yahoo.co.in$. S. B. Bhardwaj is with the Department of Physics, Kurukshetra University, Kurukshetra - 136119, India, email: sbbhardwaj09@gmail.com. Fakir Chand is with the Department of Physics, Kurukshetra University, Kurukshetra -136119, India, email:fchand@kuk.ac.in. Anand Malik is with the Department of Physics, Ch. Bansi Lal University, Bhiwani-127021, India, email:malikindia@gmail.com