ANNALS of Faculty Engineering Hunedoara – International Journal of Engineering
Tome XXIV [2026] | Fascicule 3 [August]

[1.] A. S. AJANI, [1.] O. O. OLUBANWO, [1.] M. A. AYODELE, [1.] H. A. HARUNA, [1.] Y. O. KAZEEM, [1.] A. O. BECKLEY

SOLUTION OF FISHER'S EQUATION USING SUMUDU–ADOMIAN DECOMPOSITION METHOD

[1.] Department of Mathematical Sciences, Olabisi Onabanjo University, Ago–Iwoye, NIGERIA

Abstract: This paper investigates the use of the Sumudu–Adomian Decomposition Method (SADM) to obtain approximate analytical solutions for Fisher's Equation, a nonlinear partial differential equation that models reaction–diffusion processes such as population growth and gene propagation. The main purpose is to develop an efficient and accurate semi–analytical approach that overcomes the limitations of traditional numerical methods. The method combines the Sumudu Transform, which simplifies differential equations into algebraic expressions, with the Adomian Decomposition Method, which breaks down nonlinear terms into manageable components. This combination allows the nonlinear structure of Fisher's Equation to be handled without linearisation or discretisation. The study outlines the procedural steps of SADM and demonstrates its effectiveness through several illustrative examples with different initial conditions. The results show that the series solutions obtained by SADM converge rapidly and accurately reproduce the expected wave–front behaviour of Fisher's Equation. The approach significantly reduces computational effort while maintaining high precision. The findings confirm that SADM provides a simple, reliable, and efficient tool for solving nonlinear partial differential equations, making it suitable for a wide range of applications in science and engineering where nonlinear diffusion and growth phenomena are important.

Keywords: Fisher's Equation, Sumudu Transform, Adomian Decomposition Method, Partial Differential Equations

1. INTRODUCTION

Differential equations serve as a foundational pillar in the mathematical modeling of dynamic systems across a broad range of scientific disciplines. These equations are particularly valuable in understanding systems where the rate of change of a quantity is related to the quantity itself, making them indispensable in fields such as physics, biology, engineering, economics, and environmental science [10]. In real-world applications, many phenomena do not exhibit simple linear behavior. As a result, nonlinear differential equations are often required to capture the complexity inherent in such systems. A subset of differential equations, known as Partial Differential Equations (PDEs), involve multiple independent variables and their partial derivatives. PDEs are especially useful for modeling multidimensional processes, including the flow of heat, diffusion of substances, vibrations in mechanical structures, and the evolution of populations in space and time. These equations are divided into linear and nonlinear categories. While linear PDEs are relatively easier to solve analytically or numerically, nonlinear PDEs pose significant mathematical challenges due to the complexity of their behavior and the potential for multiple or unstable solutions [2].

One of the most influential nonlinear PDEs is the Fisher's Equation, which was introduced by the geneticist Ronald A. Fisher in 1937. Initially proposed to model the spread of an advantageous gene within a population, the equation has since been adopted in various scientific fields including population ecology, epidemiology, flame propagation in combustion theory, and chemical reaction kinetics. Fisher's Equation elegantly combines two essential processes: diffusion, which accounts for the spatial movement or spreading of a population or substance, and logistic growth, which describes the self-limiting nature of population growth due to environmental constraints. The canonical form of the equation is:

$$\frac{\partial u}{\partial t} = D\frac{\partial^2 u}{\partial t^2} + ku(1-u) \tag{1}$$

where $u(x,t)$ denotes the population density or concentration, D is the diffusion coefficient, t represents time, k stands for the growth rate constant or the reaction rate constant and x is the spatial coordinate [11]. Fisher's Equation is classified as a reaction-diffusion equation, which is a class of equations used to model the interplay between local reactions (e.g., reproduction, chemical transformation) and spatial transport (e.g., diffusion or dispersion). These equations often exhibit complex behaviors such as traveling wavefronts, pattern formation, and bifurcations.

In the context of Fisher's Equation, a well-known solution is the traveling wave solution that moves at a constant speed, representing the steady spread of an invading species or a gene through space.
However, due to the nonlinear nature of the reaction term, obtaining analytical solutions to Fisher's Equation is difficult. While certain exact solutions exist under restrictive assumptions or initial conditions, most practical problems require approximate or numerical solutions. This limitation has led to the development and exploration of various semi-analytical methods designed to produce accurate solutions without resorting entirely to numerical discretization. Among these methods, the Sumudu-Adomian Decomposition Method (SADM) has gained attention for its ability to systematically tackle nonlinear differential equations. The Sumudu Transform is an integral transform similar to the Laplace Transform but with the added advantage of preserving the original function's units. When combined with the Adomian Decomposition Method (ADM), which expresses both the solution and nonlinear terms as infinite series, SADM provides a robust framework for approximating the solutions of nonlinear PDEs. This research focuses on applying the SADM to solve various forms of Fisher's Equation.

2. SUMUDU TRANSFORM

The Sumudu transform is defined by:

$$S\{f(t)\} = F(u) = \int_0^\infty f(ut)e^{-t}dt \tag{2}$$

where u is a positive real number and $f(t)$ is a function defined for $t \geq 0$.

Table 1: Sumudu Transform of Some Functions

$f(t)$	$G(u) = S\{f(t)\}$
1	1
t^n	$n!\,u^n$
$\frac{t^{n-1}}{(n-1)!}, n = 1, 2, \ldots$	u^{n-1}
e^{at}	$\frac{1}{1 - au}$
$\cos at$	$\frac{1}{1 + a^2u^2}$
$\sin at$	$\frac{au}{1 + a^2u^2}$

3. SUMUDU-ADOMIAN DECOMPOSITION METHOD

A standard Fisher's Equation can be expressed as:

$$\frac{\partial u}{\partial t} = D\frac{\partial^2 u}{\partial t^2} + ku(1 - u) \tag{3}$$

subject to the initial condition:

$$u(t, 0) = f(t) \tag{4}$$

The equation can be rewritten as:

$$\frac{\partial u}{\partial t} = D\frac{\partial^2 u}{\partial t^2} + ku - ku^2 \tag{5}$$

Take the Sumudu transform of both sides

$$S\left[\frac{\partial u}{\partial t}\right] = S\left[D\frac{\partial^2 u}{\partial t^2} + ku - ku^2\right]$$

$$\frac{1}{u}[u(t, v) - u(t, 0)] = S\left[D\frac{\partial^2 u}{\partial y^2} + ku - ku^2\right]$$

$$u(t, v) = u(t, 0) + u.S\left[D\frac{\partial^2 u}{\partial y^2} + ku - ku^2\right] \tag{6}$$

Apply the initial condition,

$$u(t, v) = f(t) + u.S\left[D\frac{\partial^2 u}{\partial y^2} + ku - ku^2\right]$$

Take the Inverse Sumudu Transform

$$S^{-1}[u(t, v)] = S^{-1}[f(t)] + S^{-1}\left[u.S\left[D\frac{\partial^2 u}{\partial y^2} + ku - ku^2\right]\right]$$

$$u(t,v) = f(t) + S^{-1}\left[u.S\left[D\frac{\partial^2 u}{\partial y^2} + ku - ku^2\right]\right] \tag{7}$$

The series solution is given as:

$$u(t,v) = \sum_{n=0}^{\infty} u_n(t,v) \tag{8}$$

The nonlinear term is decomposed as:

$$u^2 = \sum_{n=0}^{\infty} A_n \tag{9}$$

where A_n are Adomian Polynomials defined based on $u_n$where $n = 0,1,2, \ldots$
Substituting eqn. (8) and (9) into eqn. (7)

$$\sum_{n=0}^{\infty} u_n(t,v) = f(t) + S^{-1}\left[u.S\left[D\frac{\partial^2 u}{\partial y^2} + k\sum_{n=0}^{\infty} u_n - k\sum_{n=0}^{\infty} A_n\right]\right] \tag{10}$$

The recursive relation is obtained by comparing the two sides of eqn. (10)

$$u_0(y,t) = f(t) \tag{11}$$

$$u_1(y,t) = S^{-1}\left[u.S\left[D\frac{\partial^2 u}{\partial y^2} + ku_0 - kA_0\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{\partial^2 u}{\partial y^2} + ku_0 - ku_0{}^2\right]\right] \tag{12}$$

$$u_2(y,t) = S^{-1}\left[u.S\left[D\frac{\partial^2 u}{\partial y^2} + ku_1 - kA_1\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{\partial^2 u}{\partial y^2} + ku_1 - 2ku_0u_1\right]\right] \tag{13}$$

$$\vdots$$

$$u_n(y,t) = S^{-1}\left[u.S\left[D\frac{\partial^2 u}{\partial y^2} + ku_n - kA_n\right]\right] \tag{14}$$

4. NUMERICAL EXAMPLES

Example 1. Consider the one-dimensional Fishers type equation:

$$\psi_t - \psi_{yy} - 1(1-\psi)\psi = 0 \tag{15}$$

subject to the initial condition

$$\psi(y,0) = \mu \tag{16}$$

Solution

$$\psi_t - \psi_{yy} - 1(1-\psi)\psi = 0$$

This can be rewritten as:

$$\frac{\partial\psi}{\partial t} - \frac{\partial^2\psi}{\partial y^2} - 1(1-\psi)\psi = 0$$

$$\frac{\partial\psi}{\partial t} = \frac{\partial^2\psi}{\partial y^2} + \psi - \psi^2 \tag{17}$$

Take the Sumudu transform of both sides

$$S\left[\frac{\partial\psi}{\partial t}\right] = S\left[\frac{\partial^2\psi}{\partial y^2} + \psi - \psi^2\right]$$

$$\frac{1}{u}[\psi(y,u) - \psi(y,0)] = S\left[\frac{\partial^2\psi}{\partial y^2} + \psi - \psi^2\right]$$

$$\psi(y,u) = \psi(y,0) + u.S\left[\frac{\partial^2\psi}{\partial y^2} + \psi - \psi^2\right] \tag{18}$$

Apply the initial condition,

$$\psi(y,u) = \mu + u.S\left[\frac{\partial^2\psi}{\partial y^2} + \psi - \psi^2\right]$$

Take the Inverse Sumudu Transform

$$S^{-1}[\psi(y,u)] = S^{-1}[\mu] + S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2} + \psi - \psi^2\right]\right]$$

$$\psi(y,t) = \mu + S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2} + \psi - \psi^2\right]\right] \tag{19}$$

The series solution is given as:

$$\psi(y,t) = \sum_{n=0}^{\infty} \psi_n(y,t) \tag{20}$$

The nonlinear term is decomposed as:

$$\psi^2 = \sum_{n=0}^{\infty} A_n \tag{21}$$

where A_n are Adomian Polynomials defined based on $\psi_n$where $n = 0,1,2,\dots$
Substituting eqn. (20) and (21) into eqn. (19)

$$\sum_{n=0}^{\infty} \psi_n(y,t) = \mu + S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2} + \sum_{n=0}^{\infty} \psi_n - \sum_{n=0}^{\infty} A_n\right]\right] \tag{22}$$

The recursive relation is obtained by comparing the two sides of eqn. (22)

$$\psi_0(y,t) = \mu \tag{23}$$

$$\psi_1(y,t) = S^{-1}\left[u.S\left[\frac{\partial^2\psi_0}{\partial y^2} + \psi_0 - A_0\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{\partial^2\psi_0}{\partial y^2} + \psi_0 - {\psi_0}^2\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{\partial^2\mu}{\partial y^2} + \mu - \mu^2\right]\right]$$

$$= S^{-1}[u\,[\mu - \mu^2]]$$

$$= t\,[\mu - \mu^2] \tag{24}$$

$$\psi_2(y,t) = S^{-1}\left[u.S\left[\frac{\partial^2\psi_1}{\partial y^2} + \psi_1 - A_1\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{\partial^2\psi_1}{\partial y^2} + \psi_1 - 2\psi_0\psi_1\right]\right]$$

$$= S^{-1}\left[u.S[t\,[\mu - \mu^2] - 2\mu t\,[\mu - \mu^2]]\right]$$

$$= \frac{t}{2!}[\mu - \mu^2]\,[1 - 2\mu] \tag{25}$$

The series solution is given as

$$\psi(y,t) = \psi_0(y,t) + \psi_1(y,t) + \psi_2(y,t) + \psi_3(y,t) + \cdots \tag{26}$$

$$\psi(y,t) = \mu + (\mu - \mu^2)t + \frac{t^2}{2!}(\mu - \mu^2)(1 - 2\mu) + \cdots \tag{27}$$

This series converges to the logistics equation

$$\psi(y,t) = \frac{\mu}{\mu + (1+\mu)e^{-t}} = \frac{\mu e^t}{1 - \mu + \mu e^t} \tag{28}$$

Equation (28) is the same as the result obtained in (Olubanwo et al, 2024).

Example 2. Consider a nonlinear Fisher's equation

$$\frac{\partial\psi(y,t)}{\partial t} = \frac{\partial^2\psi(y,t)}{\partial y^2} + 6\big(1 - \psi(y,t)\big)\psi(y,t) \tag{29}$$

with the initial condition

$$\psi(y,0) = e^y \tag{30}$$

Solution

$$\frac{\partial\psi(y,t)}{\partial t}=\frac{\partial^2\psi(y,t)}{\partial y^2}+6\big(1-\psi(y,t)\big)\psi(y,t)$$
$$\frac{\partial\psi}{\partial t}=\frac{\partial^2\psi}{\partial y^2}+6\psi-6\psi^2 \tag{31}$$

Take the Sumudu transform of both sides

$$S\left[\frac{\partial\psi}{\partial t}\right]=S\frac{\partial^2\psi}{\partial y^2}+6\psi-6\psi^2$$
$$\frac{1}{u}[\psi(y,u)-\psi(y,0)]=S\left[\frac{\partial^2\psi}{\partial y^2}+6\psi-6\psi^2\right]$$
$$\psi(y,u)=\psi(y,0)+u.S\left[\frac{\partial^2\psi}{\partial y^2}+6\psi-6\psi^2\right] \tag{32}$$

Apply the initial condition,

$$\psi(y,u)=e^y+u.S\left[\frac{\partial^2\psi}{\partial y^2}+6\psi-6\psi^2\right]$$

Take the Inverse Sumudu Transform

$$S^{-1}[\psi(y,u)]=S^{-1}[e^y]+S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2}+6\psi-6\psi^2\right]\right]$$
$$\psi(y,t)=e^y+S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2}+6\psi-6\psi^2\right]\right] \tag{33}$$

The series solution is given as:

$$\psi(y,t)=\textstyle\sum_{n=0}^{\infty}\psi_n(y,t) \tag{34}$$

The nonlinear term is decomposed as:

$$\psi^2=\sum_{n=0}^{\infty}A_n \tag{35}$$

where A_n are Adomian Polynomials defined based on $\psi_n$where $n=0,1,2,\ldots$
Substituting eqn. (34) and (35) into eqn. (33)

$$\sum_{n=0}^{\infty}\psi_n(y,t)=e^y+S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2}+6\sum_{n=0}^{\infty}\psi_n-6\sum_{n=0}^{\infty}A_n\right]\right] \tag{36}$$

The recursive relation is obtained by comparing the two sides of eqn. (35)

$$\psi_0(y,t)=e^y \tag{37}$$
$$\psi_1(y,t)=S^{-1}\left[u.S\left[\frac{\partial^2\psi_0}{\partial y^2}+6\psi_0-6A_0\right]\right]$$
$$=S^{-1}\left[u.S\left[\frac{\partial^2\psi_0}{\partial y^2}+6\psi_0-6{\psi_0}^2\right]\right]$$
$$=S^{-1}\left[u.S\left[\frac{\partial^2e^y}{\partial y^2}+6e^y-6e^{2y}\right]\right]$$
$$=S^{-1}\big[u.S[7e^y-6e^{2y}]\big]$$
$$=t[7e^y-6e^{2y}] \tag{38}$$
$$\psi_2(y,t)=S^{-1}\left[u.S\left[\frac{\partial^2\psi_1}{\partial y^2}+6\psi_1-6A_1\right]\right]$$
$$=S^{-1}\left[u.S\left[\frac{\partial^2\psi_1}{\partial y^2}+6\psi_1-12\psi_0\psi_1\right]\right]$$
$$=S^{-1}\Big[u.S\big[t[7e^y-24e^{2y}]+t[42e^y-36e^{2y}]-t[84e^{2y}-72e^{3y}]\big]\Big]$$
$$=\frac{t^2}{2!}[49e^y-144e^{2y}+72e^{2y}] \tag{39}$$

The series solution is given as

$$\psi(y,t) = \psi_0(y,t) + \psi_1(y,t) + \psi_2(y,t) + \psi_3(y,t) + \cdots \quad (40)$$

$$\psi(y,t) = e^y + t[7e^y - 6e^{2y}] + \frac{t^2}{2!}[49e^y - 144e^{2y} + 72e^{2y}] + \cdots \quad (41)$$

Equation (41) is the same as the result obtained in (Olubanwo et al, 2024).

Example 3. Consider the one-dimensional Fisher's equation

$$\frac{\partial\psi}{\partial t}(y,t) - \frac{\partial^2\psi}{\partial y^2} - 6\psi(y,t)\big(1-\psi(y,t)\big) = 0 \quad (42)$$

subject to the initial condition

$$\psi(y,t) = \frac{1}{(1+e^y)^2} \quad (43)$$

Solution

$$\frac{\partial\psi(y,t)}{\partial t} = \frac{\partial^2\psi(y,t)}{\partial y^2} + 6\psi(y,t)\big(1-\psi(y,t)\big)$$

$$\frac{\partial\psi}{\partial t} = \frac{\partial^2\psi}{\partial y^2} + 6\psi - 6\psi^2 \quad (44)$$

Take the Sumudu transform of both sides

$$S\left[\frac{\partial\psi}{\partial t}\right] = S\frac{\partial^2\psi}{\partial y^2} + 6\psi - 6\psi^2$$

$$\frac{1}{u}[\psi(y,u) - \psi(y,0)] = S\left[\frac{\partial^2\psi}{\partial y^2} + 6\psi - 6\psi^2\right]$$

$$\psi(y,u) = \psi(y,0) + u.S\left[\frac{\partial^2\psi}{\partial y^2} + 6\psi - 6\psi^2\right] \quad (45)$$

Apply the initial condition,

$$\psi(y,u) = \frac{1}{(1+e^y)^2} + u.S\left[\frac{\partial^2\psi}{\partial y^2} + 6\psi - 6\psi^2\right] \quad (46)$$

Take the Inverse Sumudu Transform

$$\psi(y,t) = \frac{1}{(1+e^y)^2} + S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2} + 6\psi - 6\psi^2\right]\right] \quad (47)$$

The series solution is given as:

$$\psi(y,t) = \sum_{n=0}^{\infty}\psi_n(y,t) \quad (48)$$

The nonlinear term is decomposed as:

$$\psi^2 = \sum_{n=0}^{\infty} A_n \quad (49)$$

where A_n are Adomian Polynomials defined based on ψ_n where $n = 0,1,2,\ldots$
Substituting eqn. (48) and (49) into eqn. (47)

$$\sum_{n=0}^{\infty}\psi_n(y,t) = \frac{1}{(1+e^y)^2} + S^{-1}\left[u.S\left[\frac{\partial^2\psi}{\partial y^2} + 6\sum_{n=0}^{\infty}\psi_n - 6\sum_{n=0}^{\infty}A_n\right]\right] \quad (50)$$

The recursive relation is obtained by comparing the two sides of eqn.

$$\psi_0(y,t) = \frac{1}{(1+e^y)^2} \quad (51)$$

$$\psi_1(y,t) = S^{-1}\left[u.S\left[\frac{\partial^2\psi_0}{\partial y^2} + 6\psi_0 - 6A_0\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{\partial^2\psi_0}{\partial y^2} + 6\psi_0 - 6{\psi_0}^2\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{-2e^y}{(1+e^y)^3}+\frac{6e^{2y}}{(1+e^y)^4}+\frac{6}{(1+e^y)^2}-\frac{6}{(1+e^y)^4}\right]\right]$$

$$= \frac{10e^y}{(1+e^y)^3}t \tag{52}$$

$$\psi_2(y,t) = S^{-1}\left[u.S\left[\frac{\partial^2\psi_1}{\partial y^2}+6\psi_1-6A_1\right]\right]$$

$$= S^{-1}\left[u.S\left[\frac{\partial^2\psi_1}{\partial y^2}+6\psi_1-12\psi_0\psi_1\right]\right]$$

$$= S^{-1}\left[u^2\left[\frac{25e^y(-1+2e^y)}{(1+e^y)^4}\right]\right]$$

$$= \frac{25e^y(-1+2e^y}{(1+e^y)^4}t^2 \tag{53}$$

The series solution is given as

$$\psi(y,t) = \psi_0(y,t)+\psi_1(y,t)+\psi_2(y,t)+\psi_3(y,t)+\cdots \tag{54}$$

$$\psi(y,t) = \frac{1}{(1+e^y)^2}+\frac{10e^y}{(1+e^y)^3}t+\frac{25e^y(-1+2e^y}{(1+e^y)^4}t^2+\cdots \tag{55}$$

Equation (55) is the same as the result obtained in (Olubanwo et al, 2024)

5. CONCLUSION

In this article, a new modification of Adomian Decomposition Method, called Sumudu-Adomian Decomposition Method has been applied to solve Fisher's Equations with initial conditions. The results obtained from the application of the Sumudu-Adomian Decomposition Method show that it is an effective, accurate, and efficient analytical tool for solving nonlinear PDEs such as Fisher's Equation. SADM preserves the structure of the original nonlinear equation and captures the solution behavior with a high degree of accuracy. The SADM framework is therefore extendable to broader classes of equations, including those arising in fluid dynamics, epidemiology, and population genetics.

References

[1] Alao, S., Akinboro, F. S., Akinpelu, F. O., & Oderinu, R. (2014). Numerical solution of integro differential equation using Adomian decomposition and variational iteration methods. IOSR Journal of Mathematics, 10(4), 18–22.Ali A, Humaira, Laila, et al. (2018). Analytical solution of General Fisher's Equation by using Laplace Adomian decomposition method. J Pur Appl Math. 2(3), 1–4.

[2] Almuqrin, A.H.,. Tiofack, C. G. L., Douanla, D. V., Alim, A., Alhejaili,W., Sherif M. E. Ismaeel & S. A. El–Tantawy (2025). Applications of artificial neural networks in solving nonlinear evolution equations: Wave–like and Fisher's equation. Romanian Reports in Physics 77, 102.

[3] Chen, S., Yang, S., Kevrekidis, P. G., & Zhu, W. (2025). Robust Moment Identification for Nonlinear PDEs via a Neural ODE Approach. arXiv preprint arXiv:2506.05245.Decomposition Method with Integral Transform, Mathematics and Statistics, 9(6), 976 – 983, DOI: 10.13189/ms.2021.090613

[4] El–Hachem, M., McCue, S. W., Jin, W., Du, Y., & Simpson, M. J. (2019). Revisiting the Fisher–Kolmogorov–Petrovsky–Piskunov equation to interpret the spreading–extinction dichotomy. Proceedings of the Royal Society A, 475(2229), 20190378.

[5] Idiz, F., Tano˘glu, G., Aghazadeh, N., & Mohammadi, A. (2025). An effective Legendre wavelet technique for the time–fractional Fisher equation, Research Paper Computational Methods for Differential Equations, 1–21

[6] Jena, R. M., & Chakraverty, S. (2019). Analytical solution of Bagley–Torvik equations using Sumudu transformation method,. SN Applied Sciences, 1, 1–6.

[7] Jalili, M. (2025). A Novel Homotopy Perturbation Sumudu Transform Method for Nonlinear Fractional PDEs: Applications and Comparative Analysis. arXiv preprint arXiv:2506.20457

[8] Mjthap, H. Z., & AL–Azzawi, S. N. (2021). Mixing Sumudu Transform and a Domain Decomposition Method for Solving a Space–Time Fractional Derivative of Groundwater Flow Equation. Proceedings of First International Conference on Mathematical Modeling and Computational Science: ICMMCS, 179–193.

[9] Mohammed, G.S., AL–Safia, Ahmed, A.Y.,Muna S.A. (2021). Numerical investigation for solving non–linear partial differential equation using Sumudu–Elzaki transform decomposition method. Int. J. Nonlinear Anal. Appl, 13(1), 963–973.

[10] Muhamad, D.J., Asep, K.S., Endang, R., & Jumadil, S. (2022). Solving Differential Equations of Fractional Order Using Combined Adomian Decomposition Method with Kamal Integral Transformation. Mathematics and Statistics, 10(1), 187 – 194.

[11] [11] Olubanwo, O.O., Adepoju, J.T., Ajani, A.S., Idowu, S.S. (2024). Solution of Fisher's equation using Homotopy Perturbation Aboodh Transform Method, Annals of Mathematics and Computer Science, 23, 48–59.
[12] Subartini, B., Sumiati, I., Sukono, R., & Sulaiman, I. M. (2021). Combined Adomian decomposition method with integral transform. Mathematics and Statistics, 9(6), 976–983.
[13] Usman, T et al. (2025). Numerical Solutions of the Fisher–Kolmogorov–Petrovsky Piskunov Equation on the Abundance of Chlorophyll–a in the Ocean. ITM Web of Conferences 75, 02010 (2025) ICONMAA 2024.
[14] Wang, F., Wen, S. Y., Fang, Q., & Wang, P. (2025). Application of Adomian decomposition method to fractional order partial differential equations. Thermal Science, 29(2 Part B), 1375–1381.
[15] Watugala, G. K. (1993). Sumudu transform: a new integral transform to solve differential equations and control engineering problems. International Journal of Mathematical Education in Science and Technology, 24(1), 35–43
[16] Belgacem, F. B. M., & Karaballi, A. A. (2006). Sumudu transform fundamental properties investigations and applications. International Journal of Stochastic Analysis, 2006(1), 091083.
[17] Hussein, M. A. (2022). A Review on Algorithms of Sumudu Adomian Decomposition Method for FPDEs. Journal of Research in Applied Mathematics, 8(8).
[18] Eltayeb, H., & Kılıçman, A. (2012). Application of Sumudu decomposition method to solve nonlinear system of partial differential equations. In Abstract and Applied Analysis (Vol. 2012, No. 1, p. 412948). Hindawi Publishing Corporation.

ISSN 1584 – 2665 (printed version); ISSN 2601 – 2332 (online); ISSN-L 1584 – 2665