Mrs. Sunita Das, SURF Fellow

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Details of the funding agency/ scheme	Sambalpur University Research Fellowship (**SURF**) Letter No-05681/RDC/SU Dt. 23/12/2022.
Title of the research topic	Study on Oscillatory Behavior of 2-dim Vector Solutions of Neutral Difference Systems.
Abstract of the research work (max. 300 words)	Difference equations involve discrete steps in time rather than continuous changes. They are used to model systems where changes occur in discrete intervals. These equations are often used to study systems that evolve in steps or jumps, such as population dynamics with discontinuous reproduction or financial models with discrete time intervals. The relationship between continuous and discrete dynamical system is fascinating and plays a significant role in understanding a wide range of phenomena across various scientific and engineering disciplines. Due to this, many researchers warrant specific attentions to dynamical behavior of difference equations. Difference equations are widely used in the study of population dynamics, biology, physics, engineering, economics, probability theory, computer science, and many other fields. For details on the theory of difference equations and its applications, we refer the books by Elaydi [Springer-Verlag, New York, 2005], Agarwal [Marcel Dekker, New York, 2000], and Györi and Ladas [Claren-don Press, Oxford, 1991]. Neutral difference equations

incorporate both delayed and non-delayed terms in their highest order difference operators, making them suitable for modelling scenarios where both past and present information influence the system's behavior. In all these cases, neutral difference equations provide a more accurate representation of the real-world dynamics by accounting for the effects of past states or events on the current behavior of the system. This makes neutral difference equations a powerful tool for analyzing and understanding complex systems in various domains. The theory of neutral difference equations is as rich as the theory of nonneutral difference equations. In 2004, Shan and Ge [Comput. Math. Appl.] have considered the linear neutral difference equations with positive and negative coefficients of the form:

$$\Delta[x(n) - c(n)x(n-\gamma)] + p(n)x(n-r) - q(n)x(n-\sigma) = 0 \quad (1)$$

Recently, in 2022, Tripathy *[Math. Bohem.]* has established the necessary and sufficient conditions for the oscillation of the solution of a two-dimensional linear neutral delay difference system of the form:

$$\begin{bmatrix} x(n) + p(n)x(n-m) \\ y(n) + p(n)y(n-m) \end{bmatrix} = \begin{bmatrix} a(n) & b(n) \\ c(n) & d(n) \end{bmatrix} \begin{bmatrix} x(n-\alpha) \\ y(n-\beta) \end{bmatrix}, \quad (2)$$

where $a(n), b(n), c(n), d(n)$ and $p(n)$ are real sequences. $m > 0$, $\alpha, \beta \geq 0$ are integers. However, (2) can be viewed as

$$\Delta[x(n) + p(n)x(n-m)] - a(n)x(n-\alpha) - b(n)y(n-\beta) = 0 \quad (3)$$

$$\Delta[y(n) + p(n)y(n-m)] - c(n)x(n-\alpha) - d(n)y(n-\beta) = 0. \quad (4)$$

Here we observed that, (3) and (4) are similar to (1). In the light of (1), Tripathy has studied the oscillation and nonoscillation properties of solutions of (2) when $a(n) \neq b(n) \neq c(n) \neq d(n) \neq 0$ for all n. Motivated by the work of Shan, Ge and Tripathy, we have taken an interest appropriately to a two-dimensional neutral difference system in a closed form and to prove the existence of solution of this we have used some fixed-point theorems like Krasnoselskii's fixed point theorem and Banach's fixed point theorem. we would like to investigate different works to study the oscillation, nonoscillation, linearized oscillation and asymptotic stability of the solutions of the system of two-dimensional neutral delay difference equations of linear and nonlinear type of the various forms like autonomous and nonautonomous.

Progress of the research work	This proposed work is to study the oscillation, nonoscillation, linearized oscillation and asymptotically stable of solutions of the system of two-dimensional neutral delay difference equations of linear and nonlinear type of the various forms. We have studied the oscillation, nonoscillation, linearized oscillation and asymptotic stability of the solutions of the system of two-dimensional neutral delay difference equations of linear and nonlinear type of the various forms like autonomous and nonautonomous. In spite of these, we have done some of the works. Out of these, some of them are published and some are submitted for the favor of publication in an international scientific peer reviewed journal.
Journal publication (International)	1. Arun K. Tripathy, **Sunita Das**; Necessary and Sufficient Conditions for Oscillation of Nonlinear Neutral Difference Systems of dim-2, Nonauton. Dyn. Syst., Vol. 9, 2022, pp 91-102. 2. Arun K. Tripathy, **Sunita Das**; Characterization of First Order 2-dim Neutral Delay Difference Systems, Differ. Eqn. Dyn. Syst., doi.org/10.1007/s12591-022-00618-7. 3. Arun K. Tripathy, **Sunita Das**; Oscillation of a Class of First Order 2-dim Functional Difference Systems, Rocky Mountain J. Math. (Accepted).
Conference attended	1. Presented a paper entitled "**Application of first order two-dimensional neutral delay difference systems"** in the National Conference on Differential Equations, Difference Equations and their Applications *(DEDEA)*, organized by Department of Mathematics, Sambalpur University, Jyoti Vihar, Burla, Sambalpur-768019, Odisha, India, held on 22nd March, 2023. 2. Presented a paper entitled "**Characterization of first order two-dimensional neutral delay difference systems"** in the (*Hybrid*) International Conference on Mathematical Analysis and Applications *(ICMAA)*, organized by Department of Mathematics, National Institute of Technology Tiruchirappali-620015, Tamil Nadu, India, held during December 15-17, 2022. 3. Presented a paper entitled "**Necessary and sufficient conditions for oscillation of two-dimensional nonlinear neutral difference systems"** in the (*Online*) 27th International Conference of the International Academy of Physical Sciences on Mathematical Analysis and Applications *(CONIAPS XXVII)*, jointly organized by Department of Mathematics, Central University of Kerala, India and International Academy of Physical Sciences, Prayagraj, India, held during October 26-28, 2021

Awards	1) Awarded the Sambalpur University Research Fellowship (SURF) by RDC, Sambalpur University dated on 23/12/2022.