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# Notice for the PhD Viva Voce Examination

Ms Sanjana Joseph (Registration Number: 1942074), PhD Scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Thursday, 27 February 2025 at 12.00 pm in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029, Karnataka, India.

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| **Title of the Thesis** | : | **Secure Domination in Transformation Graphs** |
| **Discipline** | : | **Mathematics** |
| **External Examiner** (Outside Karnataka) | : | **Dr Sunil Mathew**<br>Associate Professor<br>Department of Mathematics<br>National Institute of Technology, Calicut<br>Kerala - 673601 |
| **External Examiner** (Within Karnataka) | : | **Baiju T**<br>Professor<br>Manipal Institute of Technology<br>Manipal Academy of Higher Education<br>Manipal, Udupi<br>Karnataka - 576104 |
| **Supervisor** | : | **Dr Joseph Varghese**<br>Professor<br>Department of Mathematics<br>School of Sciences<br>CHRIST (Deemed to be University)<br>Bengaluru-560029<br>Karnataka |

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

**Registrar (Academics)**

**Place:** Bengaluru
**Date:** 24 February 2025

# ABSTRACT

A secure dominating set $S$ of a graph $G$ is a dominating set with the property that for every vertex $v \in V(G) \setminus S$, there exists a neighbour $u \in S$ such that $(S \cup \{v\})\{u\}$ is a dominating set. The smallest cardinality of such a set is called the secure domination number of G denoted by $\gamma_s(G)$. The transformation graph $G_{xyz}$is constructed from a graph G and the vertex set of $G_{xyz}$ is V(G)∪ E(G). For any two vertices $a$, $b$ in $V(G_{xyz})$, the associativity of $a$ and $b$ is - if they are not adjacent nor incident in $G$ and + otherwise. If both $a$ and $b$ are in $V(G)$ (or both $a$ and $b$ are in $E(G)$, or if one of $a$ and $b$ is in V(G) while the other is in $E(G)$), then the vertices $a$ and $b$ correspond to the first term $x$ (the second term $y$ or the third term $z$, respectively) of $xyz$. Two vertices $a$ and $b$ of $G_{xyz}$are connected by an edge, if their associativity in $G$ is compatible with the corresponding term of $xyz$. The permutation set of {+, −} taken three at a time corresponds to the value of $xyz$. We study the eight different transformation graphs of $G$.

In this study, we characterize graphs for which the secure domination number of the transformation graph $G_{xy+}$ is 1 or 2. Also, we prove that for any connected graph $G$ with at least 4 pendant vertices, the secure domination number is greater than or equal to the secure domination number of the transformation graph G−++. We also find a bound for the secure domination number of G− − +when $G$ is a tree. We have studied this concept for different classes of graphs and obtained results in terms of the subgraphs of the transformation graphs. This includes the given graph, line graph and subdivision graph. Eventually, G+++. is the total graph of $G$, and G− − − is the complement of the total graph of $G$. Therefore, we investigate the necessary and sufficient conditions for a graph to have $\gamma_s(G)$ equal to 1 or 2 in the case of disconnected graphs. Further, we found an additional case for which the bound, $\gamma_s(G) \leq n2$ holds true. The obtained results assist in characterizing the sharp bounds of the inequality, $3 \leq \gamma_s(G) + \gamma_s(G) \leq n+1$. We also investigate a special type of transformation graph called the total graph G+++. of $G$. We further studied the transformation graph G+++. of unicyclic graphs and bipartite graphs. Finally, we give applications for secure domination and transformation graphs. The results from this study include an encryption and decryption algorithm using line and transformation graphs. Also, analyze the cases where the secure domination number holds true when k attacks occur simultaneously.



**Keywords**: *Domination, Domination number, Secure Domination, Secure Domination number, Transformation Graph, Total Graph, Nordhaus-Gaddum inequality, Unicyclic graphs, Line graphs, Encryption, Decryption*


**Publications:**

1. **Sanjana Theresa** and Joseph Varghese Kureethara, ``Secure Domination in Transformation Graph $G_{xy+}$", *Proceedings of Jangjeon Mathematical Society*, vol. 27, no. 4, pp. 837-848, 2024.
2. **Sanjana Theresa**, Joseph Varghese Kureethara, Samiksha Shukla and Jossy P George, ``A Storage System for Data Encryption and Decryption Using Line Graphs", published in Patent Office Journal on 2nd April 2021.
3. **Sanjana Theresa** and Joseph Varghese Kureethara, ``Data Encryption and Decryption Techniques Using Line Graphs", *Data Science and Security, LNNS, Conference Proc., Springer*, vol. 290, pp. 89-96, 2021.
4. Joseph Varghese Kureethara, **Sanjana Theresa**, and Agnes Poovathingal, ``Graph Theory in Security, Utility, Aesthetics and Affordability", *AIP Conference Proceedings*, vol. 2763(1), 2023.