INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
PhD-17 SHORT ABSTRACT OF THESIS

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Thesis Title: CHARACTERIZATIONS AND PROPERTIES OF WORD-REPRESENTABLE GRAPH CLASSES

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SHORT ABSTRACT

A graph G with vertex set V(G) and edge set E(G) is said to be word-representable if there exists a word w over the alphabet V(G) such that, for any two distinct letters x,y in V(G), the letters x and y alternate in w if and only if xy in E(G).

A partial classification of 2-word-representable graphs is obtained based on the minimum length of their word-representants, establishing a connection between letter occurrences and graph diameter. Upper bounds on the minimum representation length are derived under graph operations such as edge addition and vertex gluing. Further, the behavior of representation length is analyzed for Cartesian and rooted graph products using morphism-based and occurrence-based approaches.

The thesis places strong emphasis on semi-transitivity, including the study of circulant graphs, where bounds on the representation number are obtained for certain regular cases. A key contribution is the introduction of the I-circular property for binary matrices, extending the notion of the D-circular property. This property enables a matrix-based characterization of semi-transitive split graphs and leads to a complete forbidden submatrix description, which translates into forbidden induced subgraph characterizations.

Finally, the thesis provides a structural and algorithmic characterization of word-representable co-bipartite graphs. It establishes that co-bipartite graphs are circle graphs if and only if they are permutation graphs and develops a linear-time recognition algorithm for semi-transitive co-bipartite graphs using matrix techniques. Together, these results deepen the understanding of word-representability through combinatorial, structural, and algorithmic perspectives.