INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Design and Synthesis of Novel Columnar Liquid Crystalline Molecules**

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SHORT ABSTRACT

This thesis presents the design, synthesis, and comprehensive characterization of novel liquid crystalline organic materials featuring a newly developed core structure. The optical, electrochemical, and thermal properties of the synthesized compounds are systematically studied, with a focus on understanding structure–property relationships through the incorporation of various auxiliary chromophores. In addition to their fundamental properties, the functional behavior of these materials—including electrical conductivity and potential for bioimaging applications—is explored. Notably, several compounds exhibited room-temperature discotic columnar liquid crystalline phases, underscoring their suitability for use in organic electronic devices. The research is organized into four chapters. Chapter 1 introduces the basic concepts of liquid crystals, their structural features, and technological applications. Chapter 2 describes the synthesis of molecular hybrids containing cyclic dipeptide and isatin moieties. Among them, CI5 and CI6 demonstrated columnar rectangular mesophases, with CI5 exhibiting ambipolar charge transport, making it a promising candidate for solution-processable electronics. Chapter 3 focuses on phenoxazine-based derivatives with multifunctional properties. Compound PO4 was particularly notable for its room-temperature columnar mesophase, strong luminescence, phosphorescence, solvatochromism, and efficient charge transport. PO4 also showed excellent biological compatibility, enabling its successful use as a fluorescent probe for imaging MCF7 breast cancer cells. Chapter 4 investigates a series of indole[2,3-b]quinoxaline-based donor–acceptor molecules. IQ3 and IQ4 stabilized well-defined mesophases and exhibited strong aggregation-induced emission (AIE), highlighting their potential in solid-state lighting and bioimaging applications.
Overall, this work provides valuable insights into the molecular design of multifunctional liquid crystalline materials with applications spanning organic electronics and biomedical imaging.