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Departmental Seminar

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Seminar Title	: Performance analysis of compact Joule-Thomson cryocooler using Aspen-HYSYS optimization tool
Speaker	: Alok Palatasingh
Supervisor	: Prof. Saurav Datta, PIC (Departmental Seminar)
Venue	: Seminar Hall (Room Number: ME -001)
Date and Time	: 18 Dec 2024 (15:00 )
Abstract	: The Joule-Thomson (JT) cryocooler is a critical technology for achieving cryogenic temperatures in compact, reliable systems. This is relevant for applications requiring minimal vibration and noise, like infrared detectors, superconducting electronics, and space-based instrumentation to operate at a high frequency. The JT cryocooler operates on the gas expansion principle through a throttle valve, leading to cooling without moving parts at the cold finger. The current approach incorporates a detailed study of the design parameters, cooling capacity, and temperature stability of a compact JT cryocooler. The working fluid, He4, is compressed, subsequently cooled through recuperators and two-stage coolers to reach 20 K, and then expanded through a JT valve to achieve a cooling effect of 150 mW at a temperature of 4 K at the cold finger. Recent advancements in miniaturization and hybrid systems, where JT cryocoolers are combined with other cryogenic technologies like Stirling and Pulse tube cryocoolers, are also explored, and the performance of JT cryocoolers is optimized by the Aspen-HYSYS optimization tool. This study investigates the effect of parameters such as mass flow rate, pressure ratio, and stage cooling temperature on the cooling effects. The present work predicts the optimal pressure ratio and the figure of merit (FOM) as 14 and 39%.