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Ph.D. Seminar Talk 2

Title: **Cloud-Enabled Cyber–Physical Digital Twin for Intelligent Micro-Turning: IIoT Integration, Predictive Modeling, and Adaptive Process Control.**

Speaker: Mr. Tere Rajesh Babu (ME17D019)
Ph.D. Research Scholar for the Department of Mechanical Engineering,
IIT Madras.

Date and Time: **05-05-2026 @ 3:00 PM**

Venue: **NAC-II, Room No. 363 &**
Google Meet Link: https://meet.google.com/eit-umae-dro

Abstract

Micro-turning is a precision manufacturing process where size effects, rapid tool wear, and process instability significantly affect machining performance. To address these challenges, this work presents a cloud-enabled cyber–physical Digital Twin framework for intelligent monitoring and adaptive control of a micro-turning system. A custom-developed micro-turning machine integrated with an IIoT-based edge–cloud architecture enables real-time acquisition of multi-modal data, including spindle load, position, vibration, and process parameters. Data-driven machine learning models are developed to predict tool wear, remaining useful life, and surface roughness with high accuracy. These predictions are utilized within an intelligent decision-making module to recommend optimal cutting parameters and enable in-process adaptive control. The Digital Twin is implemented using a Unity-based environment for real-time visualization and interaction. The proposed system demonstrates a practical approach toward autonomous, data-driven micro-machining, advancing smart manufacturing and self-optimizing machining systems.