THE TECHNOCRACY
STUDENTS' TECHNICAL COMMITTEE, NIT RAIPUR

AAVARTAN'25-26

VIGYAAN

DEPARTMENT OF METALLURGICAL & MATERIALS ENGINEERING

PROBLEM STATEMENTS

MME01: Hydrogen-Based Direct Reduction of Iron Ore

Develop an economically viable hydrogen-based or hybrid direct reduction process for iron ore that significantly lowers carbon emissions compared to traditional coke-based reduction routes. The solution should improve hydrogen utilization efficiency, maximize the production and demonstrate the technical and economic viability of hydrogen as a sustainable reducing agent for large-scale iron and steel production.

MME02: Control of Metal/Slag Skull Formation in Ladles

Design a practical and industry-feasible solution to prevent, reduce or safely remove solidified metal/slag build-up (skull) from the inner walls of ladles or molten metal containers without causing damage to the refractory lining.

MME03: Advanced Slag Utilization in Steel Production

Develop sustainable processes to convert steel slag into high-value products, enhancing resource recovery and significantly reducing the environmental footprint of steel production. The solution should consider compositional variability across different slag types, enable sustainable resource recovery and demonstrate technical feasibility and commercial relevance as an alternative to conventional low-grade utilization methods.

MME04: Control of Phosphorus Reversion in BOF Steelmaking

Design a slag management and BOF tapping strategy to minimize phosphorus reversion during and after tapping, ensuring improved steel cleanliness and consistent achievement of target phosphorus levels.

MME05: Smart Energy Management System for Steel Production Plants

Develop an intelligent energy management system for steel production plants that optimizes energy utilization across all major processing operations to support higher efficiency and reduced environmental impact. The solution should incorporate real-time operational insights and predictive decision-making to dynamically balance energy loads, minimize wastage and enhance overall sustainability without affecting production quality.

MME06: Automated Slag Removal System

Develop an automated slag removal system for small foundry operations where manual processes pose safety risks. The solution should consider worker safety, improve slag removal efficiency and maintain consistent product quality while being reliable and affordable for small industries.

MME07: Enhancing Sinter Quality Consistency with Variable Ore Fines

Design a sinter quality control approach to achieve consistent Tumbler Index (TI), Reducibility Index (RI) and FeO levels under varying iron ore fines chemistry and particle size distribution. The solution should demonstrate how raw mix preparation and sintering parameters can be adjusted to minimize return fines and ensure stable sinter performance.

MME08: Energy Recovery from High-Temperature Industrial Waste Heat

Develop an efficient and economically viable system for recovering high temperature industrial waste heat and converting it into useful energy. The solution should be modular for easy integration into existing industrial setups and contribute to improved energy efficiency, reduced emissions and lower operational costs, supporting more sustainable industrial practices.