THE TECHNOCRACY
STUDENTS' TECHNICAL COMMITTEE, NIT RAIPUR

AAVARTAN'23-24

VIGYAAN
DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
PROBLEM STATEMENTS

META01. <u>The challenge of phosphorus reduction in steel produced directly from DRI through induction root.</u>

In the current era of research, focusing on green technologies as a consequence, the consumption of fossil fuels in the production of steel is disregarded. So, the use of DRI directly induction melting becomes found to be a new root in steel production, however, the scope of dephosphorization of molten steel in induction melting root is limited. To assure good quality and to compete for the international market it is necessary to achieve a phosphorus level of steel should be less than 0.03%. An Innovative process root to produce low phosphorus quality steel using an induction furnace and DRI is a challenging problem of the day. So, your task is to suggest suitable alternatives to Blast furnace root for large-scale High-quality steel production.

META02. <u>Create an environmentally conscious metal 3D printer design to tackle the intricate challenge of sustainable additive manufacturing for complex metallic shapes.</u>

Additive manufacturing is emerging as an advanced technique to manufacture complex structures in 3-D printing roots. How metal can be 3-D printed to form complex metallic shapes is a great challenge in 3-D printing technology. What processes can be used to design a 3-D printer for metals in an open challenge. your task is to propose a design model for a metallic 3-D printer.

META03. Innovate processes to attain globally recognized structural aluminum alloy.

Production of international standard quality aluminum alloys for structural applications is a business challenge for Indian aluminum industries. The grain refinement and achieving a suitable microstructure in impurity-free aluminum is a processing challenge. Propose a suitable solution to modify the existing processes to achieve a global standard of aluminum alloys.

META04. Optimization of Corrosion Resistance in Multi-Principal Element Alloys.

Corrosion is a pervasive challenge in various industries, from aerospace to infrastructure. Multi-principal element alloys offer a promising avenue for enhanced corrosion resistance, but understanding the intricate relationships between alloy compositions and corrosion performance is complex. Your task is to approach that identifies optimal descriptors and models the corrosion resistance of these alloys, revolutionizing materials' design.

META05. Enhancing Consistency of Sinter Characteristics for Economical Pig Iron Production.

A steel manufacturer produces pig iron through blast furnace roots. The major raw materials used are iron ore, limestone/dolomite, and coke. A company observes that due to the lack of supply of good quality ore and iron ore and associated hike in the prices of these raw materials resultant pig iron production is uneconomical. The company also found as an alternative they find that iron ore is found at low prices. therefore, they dic=scide the iron ore fine in the form of a sinter with the appreciation that the use of a sinter in a blast furnace increases the rate of production, reduces the coke rate, and thus reduces the production cost.
The company started using ore fines by setting up a new sinter plant. Input to the sinter plant or iron ore fines, lime and dolomite fines, coke breeze, mill scale, quick lime, black furnace return, cold sinter return, hot sinter return, and flue dust. The company has performed several trials to get the required properties of sinter, but they have observed that the sinters produced in their sinter plant have irregular characteristics (measured by basicity ratio ((CaO%+MgO%) ⁄(SiO_2%)), tumbling index (TI) and reduction degradation index (RDI) even after maintaining uniform operational parameter. The details of compositional and sinter property data obtained during these trials are available if required You as a Metallurgical Engineer suggests a suitable reason for fixing the irregularity of the sinter characteristics that can be used for the production of pig iron through the blast furnace route.

META06. Develop an environmentally conscious, advanced integrated steel plant design optimizing technology and location for efficient steel production.

The modern world heavily relies on steel as a fundamental building material for various industries. To cater to the growing demand, a company aims to construct an integrated steel plant that efficiently produces steel while minimizing its environmental impact. Your task is to propose an innovative and sustainable design for this integrated steel plant. Your proposal should include the optimal location for the plant, the recommended technologies for different production units, and a focus on minimizing the ecological footprint. Design an Integrated Steel Plant that incorporates and optimizes cutting-edge technologies like hot blast stove technologies, fuel-efficient technologies, fuel gas recycling technologies, development of top charging technology and auxiliary fuel injection technology, and environmentally conscious practices to ensure efficient and sustainable steel production.

META07. Propose an automated quality control system for surface defects in continuous steel rolling using advanced imaging and machine learning technologies.

During the rolling of long flat products in continuous and semi-continuous mills, few surface defects such as central bursting, oxide entrapment, surface crack, or frequently conserved defects. In continuous production lines, these defects impact the productivity and quality of the rolled steel. In conventional methods, the problems are identified by visual inspection and discarding the defective part interrupting the quelling of the long product. The industry is looking for an automatic process for this quality control activity. Suggest a suitable automotive-controlled system using the latest imaging and machine learning technologies.