**Indian Institute of Technology Kanpur**
Dept. of Materials Science and Engineering &
Kotak School of Sustainability

**Executive Development Program**
*Building Green Steel Leadership*


# Sustainable Production of Green Steel

IIT Kanpur
September 16 – 18, 2024

Prof. Rajiv Shekhar, Co-ordinator
Prof. Dipak Mazumdar
Prof. Amarendra Kumar Singh

## Overview

Steel production capacity in India is expected to double to 300 MT by 2030. The steel industry is a significant contributor (12%) to domestic CO2 emissions; its CO2 emission intensity (2.55 t CO2/tcs) is ~35% higher than the global average . Steel is also a key driver for inflation in India. It is also inevitable that, in time, domestic steel companies will be integrated with the global economy through ownership and exports. Consequently, the industry must transition to the sustainable production of fossil fuel free (green) steel, while continuing to lower production costs. The increasing emphasis on sustainability implies that the green steel manufacturing process must also account for the social and governance impacts during the entire life cycle of steel. **This EDP is the first step in building the next generation of green steel leaders through a comprehensive introduction to the concept, tools, and technology interventions for sustainable production of green steel (SPGS).**

## Objectives

This EDP will provide middle-to-senior management in integrated and mini steel plants a state-of-the-art overview of:

1. Sustainability and circular economy related to steel production.
2. Financial impact of circularity interventions.
3. Use of hydrogen.
4. Carbon capture technologies.
5. Application of AI/ML and digital technologies.
6. Technology interventions to reduce carbon emissions.

Green Steel

# Modules

**Sustainability and circular economy**
- UN Sustainability development goals.
- Sustainability in steel plant operations.
- Circular economy for steel value chain
  ~ Life Cycle Analysis
- Life Cycle Costing
  ~ Social impact assessment.
  ~ Circularity indicators.
  ~ Circularity certification.

**Financial impact of circularity interventions**
- Carbon pricing models.
- Cost estimation: CAPEX, OPEX.
- Net present value (NPV).
- Depreciation, taxes, ROI, profitability.
- Environmental value, societal value.

**Industrial case study sessions by participants.**

**Use of hydrogen in steel plants**
- Impact on performance and productivity.
- Retrofitting blast furnace and DRI reactors
- Novel ironmaking processes using ore fines.
- High ash coal gasification.
- Refractories for hydrogen-based steel.

**Interventions to reduce carbon emissions**
- Mineral beneficiation.
- Sintering, coke oven design.
- BOF and EAF design for greater DRI/scrap consumption.
- Harnessing waste heat.
- Process heat from solar thermal technology.

**Digital technologies and AI/ML**
- Autonomous control of unit operations.
- Optimize resource consumption.
- Digital twins.

**Carbon capture technologies**
- Conventional amine technology.
- Mineralization using BOF slag.

# Main Instructors

**Prof. Rajiv Shekhar** is an extractive metallurgist and a faculty of Materials Science & Engineering (MSE), IIT Kanpur since 1990. He is also a former Director of IIT (ISM) Dhanbad. Prof. Shekhar's primary expertise lies in the design of metallurgical reactors such as Hall-Heroult cell and Pachuca tanks, refining of spent nuclear fuels, and electrochemical extraction of Nd. He has offered workshops on EIA and Environmental Audit. He also supervised the development of an Integrated Software Platform for EIA of thermal power plants. During the last decade, Prof. Shekhar has worked extensively on the design and development of air-based concentrated solar thermal technology for generating high temperature process heat. The concept of a fossil-fuel free, air-fired solar convective furnace for metals processing has been proposed by Prof. Shekhar and his collaborators.

**Prof. Dipak Mazumdar** is an internationally recognized personality in steel education and research. A recipient of thirteen national and international awards, Prof. Mazumdar has been teaching and conducting research at IIT Kanpur since 1987. He has collaborated extensively with the domestic steel industries during the past decades. Prof. Mazumdar works as a consultant for more than a dozen steel (Sunflag, JSL, SLR Metalliks, Hospet Steel etc.) and refractory industries (OCL, Hitech etc.). Notably, Prof. Mazumdar's interventions have led to an annual yield improvement from tundish to the tune of Rs. 500 crores. Prof. Mazumdar is a recipient of the Vasvik Industrial Research Award (2010), Ministry of Steel Chair at IIT Kanpur (2012 – 2017), and distinguished educator award from INAE and IIM.

**Prof. Amarendra Kumar Singh** is with MSE at IIT Kanpur since 2015. He had 23 years of industrial research experience at Tata Consultancy Services (TCS) Innovations Lab - TRDDC, Pune. Some of his notable contributions are the development of (i) Electric Arc Furnace Optimization Tool (EAF_OPT), (ii) Ladle Furnace Online Reckoner (LFOR), an advisory system for control of temperature and chemistry during LF operation, and (iii) CFD based model of tundish for tighter temperature control in slab casting. Prof. Singh is a recipient of the Metallurgist of the Year Award from the Government of India and the TCS Distinguished Scientist Award. He also serves on the editorial boards of Metallurgical and Materials Transactions B and Transactions of IIM.

# Instructors from Industry

**Dr. Ashok Kumar** is Head of Strategic Technical Development, Tata Steel in UK. Earlier he was General Manager Technology, Iron and Steel, Tata Steel in Europe. He also served as Chief Technology Officer (Process), in Tata Steel, Jamshedpur.

**Dr. Pradip** is a former Vice President (Technology), TCS, and Head, Tata Research Development and Design Centre (TRDDC) Pune. He is a leading mineral beneficiation expert in India.

**Dr. Indra N. Chakraborty** is Technical Consultant, Calderys India Refractories Limited, Nagpur.

**Prof. Sheo Shankar Rai** is a Professor of Mining Engineering at IIT(ISM) Dhanbad. He has over 29 years of industry experience in both public and private sector mining companies. He was also the CEO of Runge Pincock Minarco (India).

# Instructors from IIT Kanpur

**Prof. Laltu Chandra** is Associate Professor of Sustainable Energy Engineering at IIT Kanpur. He is a leading expert in the design of concentrated solar thermal systems for high temperature process heat applications. Prof. Chandra also proposed the concept of a fossil-fuel free, air-fired solar convective furnace for metals processing with his collaborators. He is currently working on the use of solar thermal energy for production of hydrogen by thermochemical splitting of water.

**Prof. Raghavendra Ragipani** is Assistant Professor of Chemical Engineering at IIT Kanpur. His active research area is carbon dioxide capture and mineralization using alkaline solid wastes such as steel slag and fly ash.

# Course fees and Payment

| Course Code | IITK/CCE/2024-25/010 |
|---|---|
| Course Title | Sustainable Production of Green Steel |
| Course Duration | 16.09.2024 - 18.09.2024 |
| EDP size | 30 participants |
| Participants Category, Course Fees including GST | Industrial Participants (Rs. 50,000/-). Fees includes boarding and lodging (single occupancy AC) at the IIT Kanpur Guest House. |
| PAN and GST numbers | AAAJI0169A and 09AAAJI0169A1ZN |

## SBI Collect fee payment

1. Click https://www.onlinesbi.sbi/sbicollect/icollecthome.htm
2. Click **Educational Institutions.**
3. Search and select **Indian Institute of Technology Kanpur.**
4. Select **CDTE Workshops** in payment category.
5. Complete the form using details from the above table.
6. Please note and preserve the transaction number.

For queries related to invoice and payment, please contact:
Mr. G. P. Bajpai, email: gpbajpai@iitk.ac.in, Cell: 9415511491

For queries related to the EDP, please contact:
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**Green Steel Logo: Prof. Shatarupa T. Roy**