

Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NFMC519	Advanced Iron-Making Technologies	3	1	0	4

Course Objective
The main objective of the course is to introduce the students with recent technologies in the field of iron-making
Learning Outcomes
On completion of the course, students will be able to understand the fundamentals of iron-making with recent technological developments.

Unit	Topics to be covered	Lecture Hours	Tutorial Hours	Learning Outcome
1	Introduction: Early history of iron making (world & India), Evolution of iron making technologies, Alternative methods of iron making.	4	0	Knowledge about the history of the subject
2	Science base fundamentals of iron making: Metallurgical thermodynamics - Chemical equilibrium, activity and equilibrium constant, Standard Gibbs free energy for oxides, activity composition relationships, chemical potential and equilibrium.	5	3	Knowledge about the fundamentals is involved in the making process.
3	Modern blast furnace: Furnace details- stack, bosh, tuyers, combustion zone, and hearth. Raw materials storage and handling, Materials of iron and metallurgical coke. Burden Preparation- Agglomeration of iron ores (Pelletizing, Sintering, Briquetting, and Nodulizing).	8	2	Knowledge of blast furnaces and raw materials of iron making.
4	Thermal and Chemical features of blast furnace: Mass and Heat balance, raft calculation, Concept of ideal blast furnace, Thermal reserve zone, chemical reserve zone, The RIST diagram.	5	4	Knowledge of heat and mass balance of blast furnace process.
5	Alternative iron-making: the need for alternative iron units, scrap availability, and demand, fundamental of Direct reduction.	3	0	Knowledge of alternative iron-making routes.
6	Direct Reduction Processes: broad classification of DR Processes, details of individual DR Processes- SL/RN, FASTMET, COMET, IT MK3, CIRCOFER, FINMET, FIOR, CIRCORED, MIDREX and HYL etc.	7	2	Knowledge of Solid-state direct reduction processes.
7	Smelting Reduction Processes: Mini-blast furnaces, COREX, FINEX, FASTMELT, HISMELT, TECHNORED, ROMELT AND PLASMAMELT etc.	6	2	Knowledge of smelting reduction processes.
8	Process with potentials: Hydrogen Plasma Smelting Reduction (HPSR), Molten oxide Electrolysis (MOE), Alkaline Iron Electrolysis (AIE). Challenges of hydrogen reduction technologies.	4	1	Knowledge of upcoming technologies in the field of iron making.
Total		42	14	

Text Books:

1. Sponge iron production by direct reduction of iron oxide, Amit Chatterjee, PHI learning private limited, New Delhi, India.
2. Hot Metal Production by Smelting Reduction of Iron Oxide, Amit Chatterjee, PHI learning private limited, New Delhi, India.
3. Hydrogen assisted direct reduction of iron oxides, Pasquale Cavaliere, Springer.

Reference Books:

1. An introduction to modern iron making: RH Tupkary, Khanna Publishers, India
2. A first course in iron and steel making: Dipak Majumdar, University Press-IIM Series, India
3. Iron making and Steelmaking Theory and practice: A Ghosh, PHI, India