GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Metallurgy Engineering

Subject Code: DI04021041

Subject Name : Iron Making

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	PCC

Prerequisite:	Basic knowledge of science and mineral processing
Rationale:	Ferrous alloys are versatile materials having numerous applications in the engineering field as well as day-to-day life. Iron making (i.e., ferrous extraction metallurgy) is a critical process for the extraction of iron from its ore. Iron making can be processed by the blast furnace route or alternative routes, depending upon the quality of raw materials. Diploma metallurgy engineering students must be aware of the extraction process of iron from its ore by different routes. Students will be able to apply the knowledge gained from this course to the production of iron through effective and sustainable operational practices.

Course Outcome:

After completion of the course, the student will be able to:

No	Course Outcomes	RBT Level
01	Explain the concept, history, and modern iron making process.	R
02	Identify the raw materials and process them for iron making.	U
03	Explain the constructional features, reactions, products, and operations of a blast furnace, including its irregularities.	U
04	Implement alternative methods of iron making on the basis of raw materials' qualities.	U
05	Select a sustainable practice in the operation of iron making plant.	U/A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Ironmaking** 1.1. Introduction to the ferrous extraction process. 1.2. Importance of iron in the engineering field. 1.3. History of ancient Indian Ironmaking 1.4. Modern ironmaking practices. 1.5. Products of ironmaking: Wrought iron and pig iron	4	10
2.	**Raw materials of iron making** *2.1* Raw materials used for Iron making: *(a) Iron ore – types, Valuation of ore; (b) Metallurgical coke – functions, properties; (c) Fluxes – importance and types; (d) Air* 2.2 Issues of Indian's raw materials 2.3 Beneficiation of iron ore – Crushing, screening and magnetic separation 2.4 Agglomeration processes – Sintering, Pelletization, Briquetting, Nodulizing 2.5 Testing methods for agglomerates – *Drop test, Compression strength, Shatter index, Tumbler index; Reducibility test*	7	15
3.	**Blast Furnace process** 3.1. Plant layout and constructional features of blast furnace (BF) 3.2. Temperature profile of BF 3.3. Refractories used in BF 3.4. Physical and chemical properties of charging (or burden) materials 3.5. Charging systems of BF – Two bell and Bell-less top 3.6. Reactions involved in each zone of BF; Direct and indirect reduction; 3.7. Concept of Tuyere Flame Temperature (TFT) and Raceway Adiabatic Flame Temperature (RAFT) 3.8. Characteristics of pig iron and slag, Basicity and V ratio of slag 3.9. Desulpurization of hot metal 3.10. Modern trends of BF practice	14	35
4.	**Blast furnace auxiliaries and operations** *4.1.* Cleaning of BF gas – *Dust catcher, Primary and secondary*	7	15

	cleaning system 4.2. Hot blast stoves 4.3. BF cooling arrangements 4.4. Operations of BF and irregularities in operations		
5.	**Alternative methods of iron making** *5.1.* Alternative methods of Iron making - *Needs, principles, advantages, and limitations* 5.2. Raw materials and their characteristics – *iron ore, non-coking coal, natural gas, flux* 5.3. Direct reduced iron or Sponge iron processes: Merits, demerits, and types : *(a)* ***Coal-based*** *– Rotary kiln and Rotary hearth ; (b)* ***Gas-based*** *– Midrex and HyL* 5.4. Characteristics and use of sponge iron 5.5. Smelting Reduction process: Corex process 5.6. Mini-blast furnace	9	18
6	**Sustainable development in iron making plant** *6.1.* Pollution control – *Processing of steel plant waste materials and utilization, CO_2 emission, etc.* 6.2. Energy conservation practices in the plant 6.3. Green technologies for iron making	4	7
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
40	**40**	**20**	**0**	**0**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze, and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author / Editor	Publication with place, year, and ISBN
1	Basic Concepts of Iron and Steel Making	S. K. Dutta and Y. B. Chokshi	Springer, Singapore, 2020 (ISBN: 978-981-15-2436-3)

2	Ironmaking and Steelmaking – Theory and Practice	A. Ghosh and A. Chatterjee	PHI Learning, New Delhi, 2011 (ISBN: 978-81-203-3289-8)
3	Alternate methods of Ironmaking	S. K. Dutta and R. Sah	S. Chand, New Delhi, 2012 (ISBN: 81-219-4058-3)
4	An Introduction to Modern Iron Making	R. H. Tupkary	Khanna Pub., New Delhi, 2004 (ISBN: 978-81-740-9021-8)
5	Fuels, Furnaces, and Refractories	R. C. Gupta	PHI Learning, New Delhi, 2016 (ISBN: 978-81-203-5157-8)

(b) Open source software and website:

- https://youtu.be/EcPpoWNklz8
- https://youtu.be/xAVCY0WE8uM
- https://youtube.com/@ironmakingiisc8832?si=bqognN1CcVq6G6Dp
- https://youtu.be/rvlOmkaxre8?si=tIswaNhJovgKkDeY
- https://www.youtube.com/watch?v=BivYeUZao6c
- https://youtu.be/LM4VOW6xZ5Y
- https://www.youtube.com/watch?v=jc-9F5Vc9eA
- https://ibm.gov.in/writereaddata/files/06062017101255Iron%20and%20Steel%202020_6.pdf

Suggested Project List:

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a. Prepare a chart for the extraction processes of iron making.
b. Make a demonstrative model of a blast furnace.
c. Make a demonstrative model of a rotary kiln.
d. Prepare a flow sheet of different mineral dressing processes used for iron ore.
e. Prepare a report on integrated iron and steel plants in India.
f. Prepare a report on iron ore mines in India.
g. Study on sustainable development in iron making processes.
h. Prepare a brief report on the production of iron for the last five years.

Suggested Activities for Students:

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct the following activities in groups.

a) Visit the nearby industry which is engaged in Iron Making (if any) and study the processes are being used.
b) Collect the production data of any iron making industry in India, like which raw material used, which type of product they are producing, etc.
c) Collect the various types of iron and steel objects from your surroundings.

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