

GUJARAT TECHNOLOGICAL UNIVERSITY

METALLURGY ENGINEERING (21)

IRON MAKING

SUBJECT CODE: 2142107

B.E. 4th SEMESTER

Type of course: Engineering Science

Prerequisite: Basic knowledge of ores and minerals

Rationale:

Iron making program is to prepare students for careers in Engineering where Principles of Extraction of Iron ore & Reduction technology of Iron ores can be applied to the Industries engaged in Iron & Steel Production. This education at the undergraduate level will enable students to seek employment in Iron Making Industries upon graduation while, at the same time, provide a firm foundation for the pursuit of graduate studies in Metallurgy Engineering

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
PA	ALA	ESE		OEP						
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	General: History of iron making. Iron and steel industries in India. Occurrence, distribution and evaluation of raw materials (iron ore, coal and flux) for iron making.	05	10
2	Burden: Burden preparation, Burden qualities and calculation, Agglomeration-Nodulising and Briquetting, Sintering-process, variables and machines	07	10
3	Palletization: Palletization process, Theory of bonding. Mechanism of ball formation, Disc and drum palletizer, Induration of pallets, Cold bonding technique and testing of pallets.	08	15
4	Blast Furnace (B. F.) - Profile: Constructional features of blast furnace, Profile, Refractories, Accessories, Charging mechanism, Bell and bell-less charging systems.	10	15
5	B.F. – Reactions: Physico-chemical principles of blast furnace. Blast furnace reactions. Reaction in stack, tuyere zone, bosh and hearth. Thermodynamics equilibria, Direct and indirect reduction Kinetics of iron-oxide reduction, Slag-metal reactions, Desiliconization, Desulphurization.	08	15
6	B.F. – Operations: Operational steps, Blast furnace irregularities and remedial measures, Blast furnace gas, properties, cleaning and utilization.	06	10
7	B.F. : Process Developments:	06	10

	RAFT (Raceway Adiabatic Flame Temperature). Fuel injection. Oxygen injection. High top pressure. High temperature blast, their effect on coke rate and metal-impurity.		
8	Alternative Methods of Iron Making: Reduction smelting, Direct reduction processes, Fluidized bed process, Electro thermal process and mini blast furnace.	10	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
25%	30%	30%	10%	5%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. Introduction to Modern Iron Making, R. H. Tupkary, (Khanna Pub.)
2. Iron Making and Steel Making: Theory and Practice, A. Ghosh and A. Chatterjee, (Prentice Hall)
3. Principles of Blast Furnace Iron Making, A. K. Biswas, (SBA Pub.)
4. Making, Shaping and Treating of Steels, A. W. Cramb (Editor) (11th Edition, Vol. 1 & 2, AISE, Pittsburg)
5. Blast Furnace: Theory and Practice, J. G. Peacey and W. G. Davenport, (Pergamon Press, Oxford)
6. Introduction to Physical Chemistry of Iron and Steel Making, R. G. Ward, (ELBS)
7. Blast Furnace Iron Making, J. J. Gupta and Amit Chatterjee, (SBA Pub.)

Course Outcomes:

After successful completion of the course students should be able to:

- 1) Know about Elastic and plastic deformation of metallic materials
- 2) Understand effect of deformation behaviour of ductile & brittle material.
- 3) Able to understand various strengthening methods of metals & alloys.
- 4) Recognise the microstructural and property changes during stages of Annealing.

List of Experiments:

1. To measure the Bulk Density of materials
2. To measure Angle of repose
3. Proximate analysis of coke
4. Ultimate analysis of coke
5. Introduction to Briquetting machine
6. Introduction of Sintering machine
7. Introduction of Palletising machine
8. To measure Shatter index
9. To measure Mecum index

Design based Problems (DP)/Open Ended Problem:

- Design of waste Heat recovery equipment for iron making plant
- To study the effect of sintering variables on the quality of sinters products
- Design of Equipment to measure crushing strength of raw materials
- Design of Mini Blast furnace for improving yield of Metallic Iron.

Major Equipment:

- Blast furnace (Optional: Site Visit)
- Sintering Machine
- Sintering Furnace
- Disk Palletising Machine
- Shatter Machine
- carbon Sulphur Apparatus

List of Open Source Software/learning website:

- I. <http://nptel.iitm.ac.in/>
- II. www.ocw.mit.edu

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.