

LESSON PLAN-4 <sup>TH</sup> SEMESTER ( 2021)				
SUBJECT:SPONGE IRON AND FERRO ALLOYS (TH 4)				
NAME OF THE FACULTY: SUSHREE SUBHASHREE DAS				
MONTH	MODULE/UNIT	COURSE TO BE COVERED	CLASSES REQUIRED	REMARKS
APRIL	1	<b>Review of Sponge Iron Making Processes</b>	04	
		Historical Development. Reasons for Rapid growth of DR Process	01	
		Chronological Evolutions of some of the DRI Processes	01	
		Conventional versus DRI Steel Making	01	
		Direct Reduction of Iron Ore.	01	
	2	<b>Thermodynamics of Sponge Iron Making</b>	12	
		Principles of Direct Reduction Reactions.	01	
		Reaction between Coal, Oxygen and Carbon dioxide. (Set-I).	01	
		Reaction between Iron ore and CO (Set-II).	01	
		Reaction Mechanism in Coal based DRI	01	
		Reaction Mechanism in Gas based DRI.	01	
		Reduction by Carbon monoxide	01	
		Reduction by Hydrogen	01	
		Boudourd reaction and Reduction by Carbon	01	
		Carbon Deposition	01	
		Kinetics in DRI	01	
		Factors Influencing the Reducibility of Iron Ore.	01	
		Rate Controlling Theories.	01	
MAY	3	<b>Major direct reduction processes</b>	08	
		Coal based DR process using rotary kilns. SL/RN,CODIR,ACCAR,TDR,OSIL,Krupp-Rein processes.	03	
		Coal based processes using reactors other than rotary kilns. Rotary hearth processes based on Inmetco,fastmet,lt mk-3, Tunnel kiln processes kinglor-meter,hogans,	03	
		Gas based direct reduction HYL processes,MIDREX Fluidwise bed processes-FIOR-HIB	01	
		Uses of DRI in iron making and steel making	01	
	4	<b>Parameters of Sponge Iron Making</b>	08	
		Raw materials of Sponge Iron Making	01	
		Chemical and Physical Tests on iron ore: Chemical composition, Reducibility, Strength, Tumbling, Abrasion and Shatter	01	

		Index, Porosity, Bulk Density, Thermal Degradation Index (TDI).		
		Tests on Non Coking Coal: Proximate and Ultimate Analysis, Reactivity, Calorific Value, Coking Index, Swelling Index, Ash Fusion Temperature, Bulk Density	01	
		Effect of Iron Ore size on Reduction	01	
		Carbon Enrichment of Sponge Iron	01	
		Differentiate between killed steel semi killed steel and rimming steel	01	
		How Carbon Enrichment of Sponge Iron is performed Flow of Solids in the Reactor or Kiln	01	
		Process Parameters of Sponge Iron Production: Raw materials, Iron Ore Feed Rate, Coal Feed Rate, C/Fe Ratio, Dolomite Feed, Rate, Reduction Coal to Blow Coal Ratio , Ratio of coarse and Fines in Blow Coal, Blow Coal Pressure, Temperature Profile, Kiln Speed, Ore Retention Time and Cooler Discharge end Pressure. Nonmagnetic Percentage in the Kiln Discharge	01	
JUNE	5	<b>DRI Plant Operation and Abnormalities</b>	08	
		Daily Operating Parameters	01	
		Operational Abnormalities: Process Pressure Fluctuations, Temperature Deviations, Back Spill, Loss of Process Fan(s), High Temperature of Cooler Discharge, Loss of Product Quality	01	
		Major Problems of DRI Kiln Operation: Injection Coal Jam, Feed Pipe Jam, Transfer Chute Jam, Main Drive Problem, Refractory Failure their causes and remedies	02	
		Shutdown Procedure: Normal Shutdown Schedule for a 500 TDP Kiln.	01	
		The Start Up process: Heating of the Reactor Refractory	01	
		Accretion Formation	01	
		Key notes on process plant operation.	01	
	6	<b>Quality Control in Sponge Iron Plant</b>	06	
		Sampling: Sponge Iron and the Raw materials	01	
		Chemical Analysis of Sponge Iron, Iron Ore, Lime Stone/Dolomite and Coal	02	
		Scheme of Quality Control of input Raw Materials: Reactor Feed Iron Ore, Reactor	02	

		Feed Coal, Back –Spill Coal, Slinger Coal.		
		Determination of Total Iron (FeT), Ferrous Iron and metallic Fe	01	
JULY	7	<b>Environmental Management in DRI Plants</b>	06	
		Air Pollution Mitigation Measures	01	
		Fugitive Dust Generation	01	
		Water Pollution Mitigation Measures		
		Solid Waste Generation and Disposal	01	
		Hazardous Wastes and Chemicals	01	
		Occupational Health and Safety	01	
		Environmental Monitoring	01	
		Environmental Standards		
	8	<b>Production of Ferro-alloys</b>	8	
		Introduction to Ferro-alloying elements.	01	
		Different Ferro alloys.	01	
		General methods of producing Ferro alloys: carbothermic and aluminothermy reductions,	02	
		Refining of Ferro alloys.	01	
		Production of individual Ferro alloys: Ferro manganese, Ferro chrome, charge chrome, ferrosilicon Fe-Ti, Fe-W, Fe-Mo and Fe-V.	03	