



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3162113

Semester – VI

Subject Name: Fuels, Furnaces, Refractories and Pyrometry

Type of course: Engineering Science

Prerequisite: Knowledge of Elements of Metallurgy and basic science skills

Rationale: The Fuels, Furnaces, Refractories and Pyrometry course is to prepare students for careers in metallurgy engineering where knowledge of Fuels, Furnaces, Refractories and Pyrometry can be applied to the advancement of technology. All important metallurgical operations like extraction of metals, melting, heat treatment etc. are carried out in various metallurgical furnaces. Fuels are basic requirements of furnaces and play a major role in quality and cost of any metallurgical product. Optimum utilization and quality control of fuel is must in metallurgical operations. Refractories are very important material for construction of furnaces which help in the efficient utilization of heat in furnace. Knowledge of Temperature Measurement and Control is must for functioning of furnaces. Thus Fuels, Furnaces, Refractories and Pyrometry course will enable students to solve metallurgical problems 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 C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	1	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
1	Temperature Measurement and Control: Basic concept of temperature measurement and control. Thermocouples: Principal, calibration, types and advantages. Optical and Radiation pyrometers: principle, construction, working and advantages.	4
2	Fuels - General : Definition, Comparative study of solid, liquid and gaseous fuels. Constitution, classification and grading of coal. Testing of fuels like: Grindability, Caking properties, calorific value, Proximate and ultimate analysis, Flash and Fire point, viscosity etc. Non-conventional Energy Resources like Nuclear fuel, Solar, Wind, etc.	6
3	Fuels - Manufacturing: Carbonization of coal: Coke making and by-products. Producer gas, Water gas, Natural gas, LPG, Blast furnace gas, Coke oven gas, LD gas. Storage of fuels. Combustion of fuels and problems based on air supplied, excess air and products of combustion.	6



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4	Furnaces: Definition and Classification of Furnaces, Construction and working of furnaces like Cupola, Induction furnace, Arc furnace, Resistance furnace, Pit furnace, Rotary furnace, Muffle furnace etc. Evolution of heat and flame temperature. Available heat. Natural, forced, induced and balanced draft. Chimney height, Heat losses in furnaces and minimization. Waste heat recovery.	8
5	Refractories: Definition, Classification, Properties and testing of refractories. General Production method of refractories, Selection of refractories for metallurgical applications, Special types of refractories.	4
Total		28

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	35	35	10	05	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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. Elements of Fuels, Furnaces and Refractories, O. P. Gupta, Khanna publication.
2. Fuels, Furnaces and Refractories, J. D. Gilchrist
3. Fuels, Furnaces, Refractories and Pyrometry, -A.V.K. Suryanarayana, B. S. Publication
4. Industrial Furnaces - Vol. I & II, W. Trinks and M. H. Mawhiney, Wiley
5. Refractories, F.H.Norton, McGraw-Hill
6. Refractories, M. L. Mishra

Course Outcomes:

Sr. No.	CO statement	Marks % Weightage
CO-1	Understand furnaces with relevant refractory material appropriate fuel and temperature measurement devices.	50%
CO-2	Apply fuels, furnaces and refractories for metallurgical applications.	40%
CO-3	Analyze causes of heat losses in furnaces and manage waste heat.	10%



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List of Open Source Software/learning website:

1. <http://nptel.iitm.ac.in/>
2. www.ocw.mit.edu