GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3150509

Semester – V
Subject Name: Fuels and Combustion

Type of course: Open Elective Corse

Prerequisite: Material and Energy Balance Calculations

Rationale: Fuels and combustion course introduces basic knowledge about solid, liquid and gaseous fuels, their origin, classification, preparation procedure and characterization in terms of physico-chemical properties. Coal being the main solid fossil fuels, its mining, cleaning and combustion processes covered in detail. Petroleum is the liquid fuel which is elaborated in terms of exploration, evaluation, distillation and secondary processing. Different important gaseous fuels are also included. It also covers fundamentals of combustion along with and combustion appliances. Emphasis is given to combustion of various fuels considering thermodynamics. Combustion appliances are discussed in Combustion technology section. Basic knowledge of advance topics like continuous industrial furnaces and oxy-rich combustion is also incorporated for wide exposure and realising importance of the subject.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Introduction :** Types of fuels, solid, liquid and gaseous fuels, History of solid liquid and gaseous fuels, production, present scenario and consumption pattern of fuels, fundamental definitions, properties and various measurements, properties of solid liquid fuels and their measurement techniques.	5
2	**Solid fuels :** Coal origin, its classification, composition, and properties. Coal mining, preparation, and washing. Combustion of coal and coke making, different types of coal combustion techniques, coal tar distillation, coal liquefaction: direct and Indirect liquefaction, coal gasification, oxidation and hydrogenation. Efficient use of solid fuels.	7
3	**Liquid Fuels :** Origin and classification of petroleum, refining, properties & testing of petroleum products, various petroleum products, petroleum refining in India, liquid fuels from other sources, storage and handling of liquid fuels.	5

4	**Gaseous Fuels :** Types of gaseous fuels: natural gases, methane from coal mines, manufactured gases, producer gas, water gas, biogas, refinery gas, LPG, hydrogen, acetylene, other fuel gases. Cleaning, purification and quality enhancement of gaseous fuels.	**7**
5	**Manufactured fuels :**Agro fuels, solid fuel handling, properties related to combustion, handling, and storage. bio-Fuels: types of bio-fuels, production processes and technologies, Bio-fuel applications.	**6**
6	**Stoichiometry of combustion :** Estimation of minimum amount of air required for a fuel of known composition, theoretical and actual combustion processes - Air fuel ratio, estimation of dry flue gases for known fuel composition, calculation of the composition of fuel and excess air supplied from exhaust gas analysis, dew point of products. calorific value of fuels, adiabatic flame temperature, mechanism and kinetics of combustion,	**9**
7	**Combustion Technology:** Stoichiometry and thermodynamics of combustion, calculation of heat of formation and heat of combustion, first law analysis of reacting system, combustion of oil, combustion of coal, combustion of gas, flue gas analysis, flame properties, draft system, combustion appliances, gas burners, functional requirement of burners, gas burner classification, stoker firing, pulverized system of firing, fluidized bed combustion process, combustion controls. Introduction to different types of furnaces: heat treatment furnaces, industrial furnaces, process furnaces, and kilns. Applications of batch and continuous furnaces, oxy-rich combustion.	**9**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	20	10	5	**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. Irvin Glassman, "Combustion" 2nd ed., Academic Press.
2. John Griswold, "Fuels Combustion and Furnaces" Mc-Graw Hill Book Company Inc.
3. S.P. Sharma & Chander Mohan, "Fuels & Combustion", Tata McGraw Hill Publishing Co. Ltd.
4. Gupta O.P, "Elements of Fuels, Furnaces & Refractories", 3rd ed., Khanna Publishers.
5. Dr. Samir Sarkar, "Fuels & Combustion", 2nd ed., Orient Longman.

6. B. I Bhatt & S. B. Thakore, "Stoichiometry", 5th ed., Tata McGraw Hill Publishing Co. Ltd.
7. James G, "Chemistry and Technology of Petroleum", Marcel Dekker, NY
8. B. K. Sharma, "Fuels and Petroleum Processing" , 1st ed., Goel publishing, Meerut.
9. Blokh A.G, "Heat Transmission in Steam Boiler furnaces", Hemisphere Publishing Corpn.

Course Outcomes: At the end of the course, the students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	summaries importance of solid liquid and gaseous fuels	20
CO-2	understand basic processing of fuels	25
CO-3	select appropriate equipment for combustion and fuel	25
CO-4	apply stoichiometry to evaluate combustion performance	30

List of Open Source Software/learning website:

Students can refer to video lectures available on the websites including NPTEL

Students can refer website of FurnXpert "https://www.furnxpert.com/casestudy" for case studies of furnace simulation and analysis.