Course Code TEE-816	Credit Hours (Th-Pr) 3.0-0	**Fuels and Combustion (Elective)**	Contact Hrs/Week (Th-Pr) 3.0-0	Total Contact Hrs (Th-Pr) 45-0

Course Outline:

Fuels and types, combustion process, combustion mechanism, adiabatic flame temperature, flame propagation, stability, kinetics, combustion aerodynamics, gaseous detonations, flame ignition and extinction and condensed phase combustion. Solid burning equipment, stokers, pulverized coal burning systems, cyclone combustors, emissions, types of fluidized beds, fluidized bed combustion, fundamentals bubbling bed, gas and liquid burners types, gas turbine combustion systems, combustion modeling. Design of combustion systems for boilers, furnaces, gas turbines and IC engines, combustion chamber performance. Propellants Types, theory of combustion, energy balance calculations.

Eligibility Criteria:

B.E in Mech., Elect (Power), Chemical, Industrial, Process

B.S (4-years) Or M.Sc. degrees in Physics

Recommended Books:

S. No.	Title	Author(s)	Assigned Code	Remarks
1.	Combustion	Irvin Glassman	IG	Text
2.	Principles of Combustion	Kenneth Kuan-yun Kuo	KK	Reference
3.	An Introduction to Combustion	Stephen Turns	ST	Reference
4	Combustion Processes in Propulsion	Gabriel Roy	GR	Reference

Course Objectives:

The overall objective of this course is to give a deep knowledge about the the characteristics of different types of fuel, and investigate into the factors governing efficient combustion. The course will also discuss the advanced knowledge about solid, liquid and gaseous fuels, their origin, classification, preparation procedure and characterization in terms of physico-chemical properties. Emphasis will be on the

combustion of various fuels in the light of thermodynamics and various combustion appliances are discussed. Various types of burner equipment will also be discussed for burning coal, oil, natural gas, wood, and low-grade fuels such as municipal waste and bio mass.

Learning outcome:

The focus of the course is to solve problems in industry. The course is intended to provide students with the following benefits:

- Understand the ongoing role of combustion of fossil and biomass-fuels, in providing a more sustainable energy source for society, and the environmental challenges to be met to achieve this
- Have a sound understanding of the principles of combustion
- Understand the complexities of industrial combustion processes
- Have a understanding of the mechanisms of combustion generated air pollution and the techniques that can be used to control them

Topics Covered:

No.	Topics	Text Book	Contact Hours
1	**Fuels** Solid fuel, liquid fuels and gaseous fuels, Production, present scenario and consumption pattern of fuels Fundamental definitions, properties and various measurements, Definitions and properties of solid fuels, Definitions and properties of liquid and gaseous fuels, Various measurement techniques Coal classification, composition and basis, Coal mining, Coal preparation and washing, Combustion of coal and coke making, Exploration of crude petroleum, Evaluation of crude, Distillation, Secondary processing, Refinery equipments, Natural gas and LPG, Producer gas, Other fuel gases	IG,KK &ST	9
2	**Chemical Thermodynamics And Flame Temperatures** Heats of reaction and formation, Free energy and the equilibrium constants, Flame temperature calculations, Sub- and supersonic combustion thermodynamics, Combustion burners, Combustion furnaces. Calculation of calorific value of fuels, Combustion air calculation	IG,KK &ST	8

	Chemical Kinetics Rates of reactions and their temperature dependence, Simultaneous interdependent reactions, Chain reactions, Pseudo-first-order reactions and the“ fall-off ” range, The partial equilibrium assumption, Chemical kinetics of large reaction mechanisms.		
3	**Flame Phenomena In Premixed Combustible Gases** Laminar flame structure and laminar flame speed. Stability limits of laminar flames. Flame propagation through stratified combustible mixtures. Turbulent reacting flows and turbulent flames. Stirred reactor theory. Flame stabilization in high-velocity streams. Combustion in small volumes.	IG,KK &ST	6
4	**Detonation** Introduction to detonation phenomena. Hugoniot relations and the hydrodynamic theory of detonations. The ZND structure of detonation wave. The structure of the cellular detonation front and other detonation phenomena parameters. Detonations in nongaseous media	IG,KK &ST	6
5	**Diffusion Flames** Gaseous fuel jets, Burning of condensed phases, Burning of droplet clouds, Burning in convective atmospheres **Ignition** Chain spontaneous ignition, Thermal spontaneous ignition, Forced ignition, Other ignition concepts	IG,KK &ST	6
6	**Environmental Combustion Considerations** The nature of photochemical smog, Formation and reduction of nitrogen oxides, SOx emissions, Particulate formation, Stratospheric ozone	IG,KK &ST	4
7	**Combustion Of Nonvolatile Fuels** Carbon char, soot, and metal combustion, Metal combustion thermodynamics, Diffusional kinetics, Diffusion-controlled burning rate, Diffusion-controlled burning rate, Soot oxidation	IG,KK &ST	6