CH-325 Fuel Chemistry

Credit Hours 2-1

Prerequisite Nil

Course Objectives

1. This course aims to introduce students to the fundamental concepts of fuels, including their types, sources, and chemical properties. It covers both conventional fossil fuels and alternative, renewable energy sources such as biodiesel, bioethanol, and biogas. Students will learn about combustion processes, environmental impacts of fuel use, and the role of alternative fuels in promoting sustainability and reducing pollution.

Detail Contents

2. Introduction to fuels and conventional fuels: what is fuel, types of fuels? Overview of fossil fuels, alternative fuels, sustainable/renewable energy sources (Solar, wind and nuclear). Fossil fuels: coal, petroleum, natural gas. Composition and chemical properties of fossil fuels. Combustion processes of fossil fuels. Environmental impact of fossil fuels: greenhouse gas emissions, air pollution. Alternative fuels, (biodiesel, bioethanol, biogas). Biomass valorization (conversion of biomass into fuels). Chemical properties and combustion of alternative fuels. Role of alternative fuels in reducing environmental impacts supporting energy needs.

Course Outcomes

By the end of this course, the students will be able to:

3. Explain the chemical properties and combustion processes of fossil fuels and alternative energy sources.
4. Analyze the environmental impact of fuel, including greenhouse gas emissions and pollution.
5. Evaluate the potential of alternative fuels and sustainable energy sources in reducing environmental impacts and supporting energy needs.

Relevant Experiments:

1. Determination of calorific value of fuels (coal, petroleum, natural gas, ethanol).
2. Proximate analysis of coal.

3. Flash point and fire point of flammable liquids.
4. Pour point and cloud point of fuel/oil. Total acid number.
5. Fractional distillation of crude oil.
6. Active sulfur content in fuel.
7. Thermal or catalytic cracking of paraffin wax and detection of unsaturation in products.
8. Production of bioethanol by fermentation of glucose.
9. Synthesis of biodiesel from vegetable oil via transesterification and measurement of its energy content.

Recommended Books

1. Speight, J. G. (2014). The Chemistry and Technology of Petroleum (5th ed.). CRC Press. ISBN: 9781040060926.
2. Schobert, H. H. (2013). Chemistry of Fossil Fuels and Biofuels (1st ed.). Cambridge University Press. ISBN: 9780511844188.
3. Qudrat-Ullah, H. (2024). Transitioning Fossil-Based Economies: Sustainable Strategies for Energy Change (1st ed.). Taylor & Francis. ISBN: 9781003558293.
4. Basu, C. (Ed.). (2021). Biofuels and Biodiesel. Humana Press. ISBN: 978-1-0716- 1325-2.
5. Speight, J. G. (2023–2025). Petroleum Refining Technology Series (Multiple volumes: e.g., Thermal and catalytic processes in refining [April 11, 2025], Gas cleaning operations [Nov 26, 2024], Hydrogen production in petroleum refining [June 26, 2024], etc.). CRC Press. ISBNs vary by volume.
6. Schobert, H. H. (2013). Chemistry of Fossil Fuels and Biofuels. Cambridge University Press. ISBN: 9781107692294.
7. Sheldon, R. A., Arends, I., & Hanefeld, U. (2020). Green Chemistry and Catalysis (2nd ed.). Wiley-VCH. ISBN: 9783527329472.
8. Kumar, R. P., Bharathiraja, B., Kataki, R., & Moholkar, V. S. (Eds.). (2020). Biomass Valorization to Bioenergy. Springer. ISBN: 978-981-15-0412-9.
9. Rao, S. B. (Ed.). (2020). Artificial Intelligence in Chemical Engineering (1st ed.). Elsevier. ISBN: 9780128194974.
10. Current publications and Literature and Review.