BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE-PILANI - HYDERABAD CAMPUS SECOND SEMESTER 2022-2023

(COURSE HANDOUT PART II)

16/01/2023

In addition to part-I (general handout for all courses in the time-table), this handout provides the specific details regarding the course.

**Course No.**: ME F482

**Course Title**: COMBUSTION

**Instructor-in-charge**: Prof. N. JALAIAH

1. **Course Description:** Fuels, Combustion, Adiabatic Flame Temperature, Chemical Kinetics, Chain Reactions, Conservation Equations for Reacting Flows, Laminar and Turbulent Premixed Flames, Diffusion Flames, Droplet and Particle Combustion, Emissions, Applications
2. **Scope and Objective:** The study of combustion is relevant to heating, electric power generation, transportation, propulsion, reducing atmospheric pollution, fire safety, etc. Starting with the review of thermodynamic fundamentals, followed by physical and chemical aspects of basic combustion phenomena, this course is designed to discuss thoroughly on the principles of premixed flame combustion and diffusion flame combustion. The objective of this course is to provide basic principles of combustion processes, to highlight the salient features in practical and scientific applications of combustion, and to establish links between combustion processes and combustion equipment and applications.

# Text Book:

**D.P. Mishra**, “*Fundamentals of Combustion*”, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.

# Reference Books:

1. **Anil W. Date**, “*Analytic Combustion – With Thermodynamics, Chemical Kinetics, and Mass Transfer*”, Cambridge University Press, New Delhi, 2011.
2. **Stephen R. Turns**, “*An Introduction to Combustion – Concepts and Applications*”, Tata McGraw Hill Education Pvt. Ltd., 3rd Edition, 2012.
3. **J. Warnatz, U. Mass and R.W. Dibble**, “*Combustion*”, Macmillan India Ltd., 4th Edition, 2006.
4. **Sara McAllister**, **Jyh-Yuan Chen**, and **A. Carlos Fernandez-Pello**, “*Fundamentals of Combustion Processes*”, Springer, 2011.
5. [**F. El-Mahallawy**](http://www.amazon.com/s/ref%3Dntt_athr_dp_sr_1?_encoding=UTF8&field-author=F%20El-Mahallawy&search-alias=books&sort=relevancerank)**,** [**S. El-Din Habik**](http://www.amazon.com/s/ref%3Dntt_athr_dp_sr_2?_encoding=UTF8&field-author=S.%20E-Din%20Habik&search-alias=books&sort=relevancerank), “*Fundamentals and Technology of Combustion”,* Elsevier Science; 1st Edition, 2002.

# Course Plan:

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| --- | --- | --- | --- |
| **Lecture Nos.** | **Learning Objectives** | **Topics to be covered** | **Chapter/ Section** |
| 1-4 | Introduction | Brief history of combustion, Types of fuels, Combustion  modes, Applications | TB: Chapter 1 |
| 5-9 | Thermodynamics of Combustion | Review of thermodynamics laws and properties, Stoichiometric reaction, Fuel-Air ratio, Equivalence ratio, Heat of combustion, Enthalpy of formation, Adiabatic  flame temperature | TB: Chapter 2 |
| 10-13 | Physics of  Combustion | Fundamental laws of transport phenomena, Conservation  equations, Transport in turbulent flow | TB: Chapter 3 |
| 14-20 | Chemistry of Combustion | Basic reaction kinetics, Fundamentals of elementary  reactions, Chain reactions, Multi-step reactions, Global kinetics | TB: Chapter 4 |
| 21-28 | Premixed Flame | Introduction, 1-D Combustion wave, Hugoniot curve, Laminar premixed flame, Burning velocity: Measurement  methods and Effects of chemical and physical variables, | TB: Chapter 5 |

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| **Lecture**  **Nos.** | **Learning Objectives** | **Topics to be covered** | **Chapter/**  **Section** |
|  |  | Flame extinction, Ignition, Flame stabilizations, Turbulent premixed flame |  |
| 29-34 | Diffusion Flame | Gaseous jet diffusion flame, Liquid fuel combustion,  Atomization, Spray Combustion, Solid fuel combustion | TB: Chapter 6 |
| 35-38 | Combustion and  Emission | Atmosphere, Chemical emission from combustion,  Quantification of emission, Emission control methods | TB: Chapter 7 |
| 39-42 | Combustion  Applications | Combustion in SI and CI engines, Gas Turbines, Boilers  and Furnaces, Pulverized and Fluidized bed Boilers | Class Notes |

1. **Evaluation Scheme**:

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| --- | --- | --- | --- | --- |
| **Evaluation Component** | **Duration**  (min) | **Weightage**  (%) | **Date & Time** | **Nature of Component** |
| Surprise Tests | 15 | 15 | Lecture Class | OB |
| Literature Survey |  | 15 | To be announced in the classroom | OB |
| Mid-Sem Test | 90 | 30 | 13-03-2023  9.30 – 11.00 AM | CB |
| Comprehensive Exam | 180 | 40 | 08-05-2023 FN | CB |

1. **Chamber Consultation Hour**: To be announced in the class room.
2. **Notices**: Students are advised to visit regularly **CMS** (Institute’s web based course management system) for latest updates and notices.
3. **Make-up Policy**: Make-up shall be given only to the genuine cases with prior intimation. No make- up shall be given for the surprise tests.
4. **Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

# Instructor-in-charge

**ME F482**