Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2022-2023

Course Handout Part II

Date: 18/10/2022

In addition to Part-I (a general handout for all the courses appended in the time table), this handout gives further specific details of the course.

Course No.	:	BITS F111
Course Title	:	THERMODYNAMICS
Instructor-in-Charge	:	JEEVAN JAIDI
Instructors	:	Jaideep Chatterjee, Jeevan Jaidi, Srikanta Dinda, D. Purnima, Ramendra Kishor Pal, Nandini Bhandaru, Iyman Abrar, Supradeepan K, KRC Murthy, Jayaprakash K S, Mrinal Ketan Jagirdar

1. Course Description:

Basic concepts and laws of thermodynamics; macroscopic thermodynamic properties; application to thermodynamic systems (closed & open); microscopic approach to estimate the entropy of a system; equation of state; efficiency, irreversibility and availability of thermdynamic systems.

2. Scope and Objective:

Thermodynamics deals with the matter, energy and the laws governing their interactions in a given system. Therefore, it is very essential to learn its importance in the design and analysis of processes, devices, and systems for effective utilization of energy as well as matter. The course emphasizes on the fundamental concepts and the laws of thermodynamics applied to the closed systems (control mass) and open systems (control volume). Irreversibility and availability are the powerful tools used in the design and analysis of systems, and therefore will be discussed in detail.

3. Expected Learning Outcome:

- ✓ Understand the fundamentals of thermodynamic systems - processes and cycles
- ✓ Solve problems related to pure substances using thermodynamic tables
- ✓ Apply the first law to systems involving heat and work interactions
- ✓ Understand the need of the second law and its applications - closed and open systems
- ✓ Solve problems using the first & second laws of thermodynamics
- ✓ Understand the basic concepts & principles of the second law - entropy, irreversibility and availability

4. Text Book (TB) and Reference Book (RB):

a. TB: Claus Borgnakke, and Richard E. Sonntag, "Fundamentals of Thermodynamics", John Wiley & Sons, Inc., 2019, 10th Edition.
b. RB: Yunus A. Cengel, and Michael A. Boles, "Thermodynamics: An Engineering Approach", McGraw-Hill, 2015, 8th Edition.
c. Adoption from books by Van Wylen and others - "Thermodynamics Tables, Figures and Charts", Notes-EDD, 2007.

5. Course Plan:

Lecture No.	*Learning objectives*	*Topics to be covered*	*Chapter & Sections in TB*
1 – 3	Understand the basic concepts and definitions pertaining to thermodynamics (TD)	Introduction, thermodynamic systems, state properties, process & cycle, specific volume, zeroth-law, temperature scales, applications	1.1 – 1.12
4 – 5	Understand the properties of pure substances (as working medium)	Pure substance, states, phase equilibrium, independent properties, equation of state, compressibility factor	2.1 – 2.3, 2.5 – 2.10
6 – 7	Use of thermodynamic tables to predict the properties of pure substances	Thermodynamic properties and tables of standard substances (as working fluids)	2.4
8 – 11	Understand the concepts of boundary work and heat transfer and solve problems of control mass (CM) as a system	Definition of work and heat and their notation, work done at system's boundary, modes of heat transfer	3.1 – 3.6
12 – 15	Understand the first law of TD for a CM and other forms of energy involved	First law for a process; internal energy and enthalpy; specific heats of ideal gases	3.7– 3.11
16 – 18	Apply the first law of TD to solve problems of CM as a system	First law as a rate equation; problem analysis & solution technique; examples of closed systems	3.13 – 3.15
19 – 21	Differentiate between control mass (CM) and control volume (CV). Understand the first law of TD for a CV (as a system)	Conservation of mass in a control volume; first law for a control volume; steady-state & transient processes	4.1 – 4.4, 4.6
22 – 23	Application of the first law of TD for a CV (as a system)	First law as a rate equation; problem solving techniques; examples of CVs (open systems)	4.7
24 – 27	Understand the need for Second law of TD and its basic concepts	Limitations of the first law & need of the second law; reversible process; heat engine, heat pump, refrigerator; Carnot cycle; COP, Kelvin-Planck & Clausius statements; Carnot cycle; thermodynamic temperature scale	5.1 – 5.11
28 – 32	Understand the principles of entropy and second law of TD for a CM (as a system)	Concept of entropy; the need and definition of entropy; entropy of a pure substance; entropy change of a reversible & irreversible processes; principle of increase of entropy, thermodynamic property relation; problem solving	6.1 – 6.11
33 – 36	Understand the formulation of second law of TD for a CM (as a system)	Second law for control volume; steady-state & transient processes; reversible process; principle of increase of entropy	7.1 – 745
37 – 39	Application of second law of TD for a CV (as a system)	Understanding the efficiency and performance of systems; problem solving	7.5
40 – 42	Understand the principles of Irreversibility & availability	Available energy, reversible work & irreversibility; second law efficiency	8.1 – 8.4

6. Evaluation Scheme:

Evaluation Component	*Duration (min.)*	*Weightage (%)*	*Date & Time*	*Nature of Component*
Midsem Test[*]	90	30	07/01; 9:00-10:30am	Closed Book
Tutorial Tests[*, $]	20	15	In tutorial classes	Open Book
Quizzes[*, $]	20	10	In tutorial classes	Open Book
Comprehensive Exam[*]	180	45	20/02; FN	Closed Book

[*]EDD Notes on "Thermodynamics Tables, Figures and Charts" will be allowed. However, it shouldn't be defaced by writing formula, equations, etc.
[$]Number of tutorial tests: 02; Number of quizzes: 02.

7. **Chamber Consultation Hour:** To be announced by the respective instructors.

8. Notices:
All notices concerning this course will be displayed in *CMS (institute's web-based Course Management System)*. Students are advised to visit *CMS* regularly for all notices and updates.

9. Make-up Policy:
Make-up request for Midsem test and Comprehensive exam shall be granted only for the *genuine* cases with sufficient evidence. Request letter duly signed by the students must reach the undersigned at least one day before the scheduled exam. No make-up for tutorial tests and quizzes.

10. Academic Integrity Policy:
It is expected that in compliance with institute rules and regulations, academic integrity should be adhered to in all the evaluation components. No type of academic dishonesty is acceptable and malpractice in any form will have serious implications.

Instructor-in-Charge (BITS F111)