

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI-**

**KK Birla GOA Campus**

**INSTRUCTION DIVISION**

**SECOND SEMESTER 2022-2023**

**Course Handout (Part – II)**

Date: 14/03/2023

In addition to Part I (General handout for all course appended to timetable), this portion gives further specific details regarding the course.

<b>Course No.</b>	:	BITS F111
<b>Course Title</b>	:	Thermodynamics
<b>Instructor-in-Charge</b>	:	Shibu Clement
<b>Team of Instructors</b>	:	Ranjan Dey, K.P. Jayadevan, Paramita Haldar, Vaibhav Joshi, Pritanshu Ranjan, Anandteerth Muddapur, Sharad Sontakke, Mrunalini Gaidhane, Ethirajulu Kannan, Rudranil Basu, Arnab Roy

**1. Course Description**

Concepts and laws of thermodynamics; thermodynamic properties; applications to closed and open systems; entropy and entropy generation.

**2. Scope and Objective**

Thermodynamics deals with energy, matter, and the laws governing their interactions. It is essential to learn its usefulness in the design of processes, devices, and systems involving effective utilization of energy and matter. The course emphasizes on the fundamentals and concepts of the laws of thermodynamics as applied to control mass and control volume systems. Irreversibility and availability are powerful tools in the design of thermodynamic systems.

**3. Text book (TB):**

- Richard E. Sonntag, Claus Borgnakke, “Fundamentals of Thermodynamics”, Wiley India, 7th Edition, 2010.
- Richard E. Sonntag, Claus Borgnakke, “Thermodynamics Data Book”, 3<sup>rd</sup> Edition, Wiley India.

**Note:** “Thermodynamic Data Book” will be allowed in the closed book examinations also. It should not be defaced by writing any formula, equations, etc.

**4. Reference books (RB):**

- Cengel Y.A. and Boles M.A. “Thermodynamics: An Engineering Approach (SIE)”, Tata McGraw Hill, New Delhi, 2017.

**Course Plan**

Lecture No.	Learning Objectives	Topics to be covered	Text book Chapt./Sec
1	Introduction	Brief description about the few devices	1
	Basic concepts, Control Volumes and Units	Thermodynamic system and the control volume, macroscopic versus microscopic point of view, properties & state, process & cycle, energy, specific volume, pressure, equality of temperature, zeroth law of thermodynamics, temperature scales	2 (Self-study)

2-5	Pure substance behavior	The pure substance, phase equilibrium, independent properties, Tables of thermodynamic properties & their use, compressibility factor, equations of state,	3.1-3.8
6-7	Energy Transfers	Definition of work and its identification, work done at the moving boundary	4.1, 4.2, 4.3,4.5
		Concept of heat, comparison of heat and work.	4.6,4.7,4.8,4.9
8-9	Energy equation for a control mass	First law for a cycle as well as for a change of state; internal energy & enthalpy; problem analysis & solution technique	5.1-5.5
10-11		Specific heats; internal energy, enthalpy & specific heat of ideal gases; first law as a rate equation; problem analysis & solution technique	5.6-5.8
12-13	Energy equation for a control volume	Conservation of mass in control volume; first law for control volume; Steady state process; examples of Steady state processes	6.1-6.4
14-15		The transient Process; examples	6.5
16-19	The classical second Law of Thermodynamics	Limitations of first law & need for the second law; The reversible process; heat engine, heat pump, refrigerator; Carnot cycle; energy-conversion efficiency and COP, Kelvin-Planck & Clausius statements, The ideal gas Carnot Cycle	7.1-7.9
20-24	Entropy for a control mass	The inequality of Clausius-A property of a system; entropy of a pure substance; entropy change of a reversible & irreversible process; principle of increase of entropy, thermodynamic property relation; problem analysis & solution technique	8.1-8.12
25-29	Entropy equation for a control volume	Second law for control volume; Steady-State and Transient Process, SSSF processes; principle of increase of entropy, Understanding efficiency and related problems; problems, Reversibility	9.1-9.6

#### Evaluation Scheme

EC No.	Component	Duration	Marks (%)	Date (time)	Nature
1	Mid-semester Exam	90 min	30	29/04/2023 (2:00 PM - 3:30 PM)	CB
2	Quiz	--	20	Two announced and two surprise quizzes. [Best of two, each from announced and surprise quiz.]	OB
3	Comprehensive exam	180 min	45	10/07/2023 (9:00 AM -12:00 N)	CB
4	Attendance		5	Based on respective tutorial section attendance	

**Chamber consultation hours:** To be announced by the respective instructors.

**Notices:** All notices concerning the course will be displayed on Quanta AWS Server.

**Make-up:** Make-up for the EC No. (only) 1 and 3 can be granted only for those students whose names appear in the “Make-up” list as forwarded by the AUGSD. No make-up for quiz under any circumstances.

Instructor–in-Charge  
BITS F111