SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Chemical Engineering	LP: CH22303 Rev. No: 00 Date: 31.07.2023
~~B.E~~/B.Tech/~~M.E/M.Tech~~ : Chemical Engineering Regulation: 2022 PG Specialisation : N/A Sub. Code / Sub. Name : CH22303 Chemical Engineering Thermodynamics I Unit : 1	

Unit Syllabus: Unit Syllabus:

Introduction-scope of thermodynamics, Dimensions and Units, Temperature, Pressure, Work, Energy, Heat, Energy conservation & first law of thermodynamics; State functions; Equilibrium; Phase Rule; Reversible process; Constant P,V, T processes; Mass and energy balances for open systems

Objective: To understand the basic concepts of thermodynamics and their usefulness.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Scope and importance of Thermodynamics	TB2: 1-2	PPT
2	Basic terminologies used. Examples of open ,closed and isolated systems	TB2: 3	PPT
3	Variables defining thermodynamic functions – measurable and un-measurable quantities	TB2: 3-4	PPT
4	Intensive and extensive properties ; state and path functions	TB2: 3-4	PPT
5	First law for closed systems. Sign conventions	TB1:23	PPT
6	Mass and energy balance for open systems	TB1:44	PPT
7	Constant PVT process	TB1: 31-37	PPT
8	Classification of energies- Potential, kinetic , internal, work and heat	TB2: 7-8	PPT
9	Reversible and irreversible process, phase rule, zeroth law of thermodynamics, temperature	TB2: 16-19	PPT
Content beyond syllabus covered (if any): Scope and application of thermodynamics in day to day life with one or two case studies.			

* Session duration: 50 minutes

Sub. Code / Sub. Name: CH22303/Chemical Engineering Thermodynamics I

Unit : II

Unit Syllabus: Statements of the second law; Heat engines, Carnot‟s theorem, Thermodynamic Temperature Scales; Entropy; Entropy changes of an ideal gas; Mathematical statement of the second law, Entropy balance for open systems; Calculation of ideal work, Lost work

Objective: To understand the fundamental laws of thermodynamics and to be able to apply the laws of thermodynamics for engineering systems.

Session No *	Topics to be covered	Ref	Teaching Aids
10.	Joule's experiment and internal energy	TB2: 24	PPT
11.	Statements of the second law of thermodynamics	TB2:90-91	PPT
12.	Heat engine and refrigerator	TB1:61	PPT
13.	Carnot cycle and Carnot theorems Heat engines based on Carnot principle.	TB2:95-97	PPT
14.	Thermodynamic temperature scale	TB2:97-98	PPT
15.	Entropy functions and its calculation	TB2:92-94	PPT
16.	Second law of thermodynamics for a control volume	TB2: 81	PPT
17.	Calculation of ideal work, Lost work	TB1: 181-185	PPT
18.	Third law of thermodynamics	TB2:118-119	PPT
19.	Proof of entropy as a state function. Entropy change of ideal gas for reference processes	TB2:103-108	PPT
20.	Clausius inequality. Entropy change and spontaneous process. Lost work	TB2:108-112	PPT

Content beyond syllabus covered (if any): Additional problem solving to calculate entropy

* Session duration: 50 mins

Sub. Code / Sub. Name: CH22303/Chemical Engineering Thermodynamics I

Unit : III

Unit Syllabus: Phases, phase transitions, PVT behavior; description of materials – Ideal gas law, van derWaals, virial, and cubic equations of state; Reduced conditions & corresponding states theories; correlations in description of material properties and behavior. Heat effects-latent heat, sensible heat, standard heats of formation, reaction, and combustion.

Objective: To understand the procedures for representing real gases and estimating their properties.

Session No *	Topics to be covered	Ref	Teaching Aids
21.	PVT behavior of real fluids	TB2: 49-51	PPT
22.	Mathematical representation of PVT behavior	TB2: 42-44	PPT
23.	Equation of state for ideal and real gases: Ideal gas law, van der Waals, virial and cubic equations of state	TB2: 51-65	PPT
24.	Compressibility factors and theorem of corresponding states	TB2: 68-69	PPT
25.	Generalized equation of state and thermodynamic energy functions	TB2: 65-67	PPT
26.	Property estimation via generalized equation of state	TB2: 65-67	PPT
27.	Fugacity and Excess properties	TB2: 244-247 317-319	PPT
28.	Revision of Unit-III	-	PPT

Content beyond syllabus covered (if any): Additional problem solving using virial equation

* Session duration: 50 mins

Sub. Code / Sub. Name: CH22303/Chemical Engineering Thermodynamics I

Unit : IV

Unit Syllabus: Thermodynamic property of fluids, Maxwell relations, Property relations, 2-phase systems, graphs, Thermodynamic property tables and Thermodynamic property diagrams

Objective: To learn the procedure to formulate complex thermodynamic functions in terms of measurable quantities.

Session No *	Topics to be covered	Ref	Teaching Aids
29	Thermodynamic potentials	TB2: 188	PPT
30	Internal energy, enthalpy	TB2: 188-189	PPT
31	Helmholtz free energy	TB2: 207-208	PPT
32	Gibbs free energy	TB1: 208-209	PPT
33	Thermodynamic property relations	TB2: 209-211	PPT
34	Maxwell's relations derivation	TB2: 211-212	PPT
35	Importance and procedure for manipulating derivatives	TB2: 191	PPT
36	Residual properties	TB2: 256-259	PPT
37	Free energy and its role in evaluating properties	TB2: 189-190	PPT
38	Thermodynamic property tables	TB2: 192	PPT
39	Thermodynamic property diagrams – P-H, H-T, T-S, H- S diagrams	TB2: 259-261	PPT
40	Construction of thermodynamic property diagrams.	TB2: 262 - 265	PPT

Content beyond syllabus covered (if any): Construction of Thermodynamic diagrams.

* Session duration: 50 mins

Sub. Code / Sub. Name: CH22303/Chemical Engineering Thermodynamics I

Unit : V

Unit Syllabus: Application of thermodynamics to flow processes-pumps, compressors, and turbines. Thermodynamic analysis of steam power plants; Rankine cycle; Internal combustion engine, Otto engine; Diesel engine; The Carnot refrigerator; Vapor-compression cycle; Absorption refrigeration Compressors, Types of Compressors with design calculation. Thermodynamic analysis of steam power plants; Liquefaction processes

Objective: To apply thermodynamic principles for compression and expansion processes.

Session No *	Topics to be covered	Ref	Teaching Aids
41	Duct flow of compressible fluids, Work required for adiabatic and isothermal compression	TB1: 254	PPT
42	Steam power plant Rankine cycle, reheat cycle, regenerative cycle	TB2: 170-178	PPT
43	Internal combustion engines – Otto engine	TB2: 180-187	PPT
44	Internal combustion engines – Diesel engine	TB1: 268-273 TB2: 128	PPT
45	The Carnot refrigerator; Vapor-compression cycle;	TB2: 170-178	PPT
46	Absorption refrigeration cycle	TB1: 317-323	PPT
47	Steam power plant Rankine cycle, reheat cycle, regenerative cycle	TB2: 170-178	PPT
48	Heat pump, Liquefaction processes	TB1:310, 326-327	PPT

Content beyond syllabus covered (if any): Brayton cycle-Gas turbine power plant

* Session duration: 50 mins

Sub Code / Sub Name: CH22303/Chemical Engineering Thermodynamics I

TEXT BOOKS:

1. J.M. Smith, H.C. Van Ness and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 7th edition, McGraw-Hill International Edition,2005

REFERENCES:

1. K. V. Narayanan, A text book of chemical engineering thermodynamics, Prentice Hall of India, 2001
2. B. G. Kyle, Chemical and Process thermodynamics. 2ndEd., Prentice Hall of India, 2000
3. M. J. Moran, H. N. Shapiro, D. D. Boettner and M. B. Bailey, Principles of Engineering Thermodynamics, 8th Edition, Willey

	Prepared by	Approved by
Signature		
Name	Dr. G. Sudha	Dr. N. Meyyappan
Designation	Associate Professor/CHE	Prof. & Head /CHE
Date	31.07.2023	31.07.2023
Remarks *: Nil		
Remarks *: Nil		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD

Verified 31/07/23

	Prepared by	Approved by
Signature		
Name	Dr. G. SUDHA	Dr. N. MEYYAPPAN
Designation	Associate Professor / CHE	Prof. & Head / CHE
	08.07.2024	08.07.2024.

Department of Chemical Engineering			CO: CH22303
~~B.E~~/B.Tech/~~M.E/M.Tech~~	:	Chemical Engineering	Rev. No: 00
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Module Coordinator

CO	Statements	RBT* Level
CO-1	Apply concepts of heat, work and energy conversion and mass and energy balances to close and open systems	3
CO-2	Envisage the entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.	3
CO-3	Evaluate the properties of non-ideal gases.	4
CO-4	Illustrate the inter relations between measurable and non measurable properties.	4
CO-5	Examine the process of liquefaction, refrigeration and different power cycles	4

***** Revised Bloom's Taxonomy

Mapping CO – PO - PSO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2
CO1	3	3	2	2	2	1	2	2	-	2	2	1	3	3
CO2	3	3	3	3	3	2	2	-	-	2	1	1	3	3
CO3	3	2	2	2	2	1	1	1	1	2	2	1	3	3
CO4	3	3	3	3	3	-	1	-	1	2	2	2	3	3
CO5	3	3	3	3	3	1	1	-	1	2	-	2	3	3

3 – Strong ; 2 – Moderate; 1 - weak

Course Requirements

1. Scientific Calculator
2. Steam Table

Assessment Methods

1. Assignment 1 + CAT 1
2. Assignment 2 + CAT 2 — Internals — 50 Marks
3. Assignment 3 + CAT 3
4. Attendance (Not applicable for R2016)
5. End semester exam — 50 Marks

Signature of Faculty / Course Coordinator	**Signature of Module Coordinator**