SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology, Surat

Bachelor of Technology (B.Tech)

B. Tech. Semester III

Subject Name: Chemical Engineering Thermodynamics-I **Subject Code: BTCH13304**

Type of course: **Professional Core Course**
Prerequisite: Physics, Chemistry and Mathematics
Rationale: Knowledge of thermodynamics from a chemical engineering view point is essential to study principles and applications of laws of thermodynamics to real systems. This subject is also useful to calculate thermodynamic properties of any chemical species and their mixtures.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	00	00	3	60	15	25	00	00	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage (%)
1.	**Introduction of Thermodynamics & Basic Concept**: The scope of thermodynamics, Intensive and Extensive Properties, Thermodynamic state, state functions and Path function, the reversible process and irreversible Processes, Heat Reservoir and Heat Engine, Internal Energy, Equilibrium state and Phase rule.	4	9
2.	**First Law of Thermodynamics**: Concept of Internal Energy, Conservation of Energy and the first law of thermodynamics, Energy balance for closed systems, The Phase rule, The reversible process, Heat capacity, and Specific Heat, Concept of Enthalpy, Application of first law of Thermodynamics to steady state flow process in heat exchanger, gas turbine, steam turbine and nozzle	7	16
3.	**Volumetric Properties of Pure Fluids**: PVT behavior of pure substances, Ideal and non-ideal gases, Equation of states for real gases such as Virial, Cubic, Vanderwaals EOS, and Redlich/Kwong (RK) EOS. Calculation of constants in terms of Pc, Tc, Vc. Generalized Correlations for gases and liquids.	7	16

4.	**Heat effects**: Heat capacities of gases as a function of temp., Heat capacity of gases, liquids and solids, Standard heat of reaction, Standard heat of formation, Standard heat of combustion, heat of vaporisation, heat of fusion, heat of sublimation, heat of formation, calculation of heat of formation from heat of combustion and calculation heat of reaction from heat of formation.	4	9
5.	**Second law of thermodynamics:** Thermodynamic temperature scale, ideal gas temp., scale, concept of entropy, entropy change and irreversibility, third law of thermodynamics.	5	11
6.	**Thermodynamic properties of fluids** : Mathematical relations among thermodynamic functions, Maxwells' relations, interrelations between H,S,U,G,Cp,Cv, properties of single and two phase systems. Types of thermodynamic diagrams.	5	11
7.	**Thermodynamics of flow processes:** Fundamental relations for flow in pipes, max. Velocity in pipe flow, throttling process, flow through nozzles, single stage and multistage compressors.	6	12
8.	**Refrigeration and liquefaction:** Carnot refrigeration cycle, air refrigeration cycle, absorption refrigeration, heat pump, choice of refrigeration, liquefaction processes.	7	16

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	25	30	20	00	00

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Introduction to Chemical Engineering Thermodynamics	J. M. Smith, H. C. Van Ness & M. M. Abbot	McGraw Hill,ISBN-10: 935316849X	2019	8th
2.	A Textbook of Chemical Engineering Thermodynamics	K. V. Narayan	Prentice Hall India Learning Private Limited	2013	2nd
3.	Chemical Engineering Thermodynamics	Y. V. C. Rao	Universities Press	1997	--

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Develop a fundamental understanding of the basic principles of chemical engineering thermodynamics and calculations.	10
CO-2	Examine and select pertinent data, and solve energy transformations problems.	15
CO-3	List examples of important application of thermodynamics laws in chemical engineering and biotechnology processes.	20
CO-4	Comprehend the concepts of Internal Energy, Kinetic Energy, Potential Energy, Work and Heat.	15
CO-5	Apply First and Second Law of Thermodynamics in engineering systems.	20
CO-6	Evaluate thermodynamic information for pure fluids as well as fluid mixtures and apply the same to perform thermodynamic calculations oriented to the analysis and design of chemical processes.	20

Mapping with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	3	2	3	2	3	3	3	2	3	3	3	3	3	3
CO-2	2	3	2	2	2	3	3	3	2	3	3	3	3	3	2
CO-3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2
CO-4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
CO-5	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO-6	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2
Rationale*	**16**	**18**	**16**	**17**	**16**	**18**	**18**	**18**	**16**	**18**	**18**	**18**	**15**	**17**	**15**

Rationale*: Explaining why it is matching this particular program outcome

List of Open Source/learning website:

https://nptel.ac.in/courses/103/101/103101004/
- Detail of coverage as per syllabus

https://nptel.ac.in/courses/103/103/103103144/
- Detail of coverage as per syllabus

https://nptel.ac.in/courses/103/104/103104151/
- Detail of coverage as per syllabus

https://www.amrita.edu/course/chemical-engineering-thermodynamics
- Detail of coverage as per syllabus

https://cosmolearning.org/courses/chemical-thermodynamics-kinetics/video-lectures/
- Detail of coverage as per syllabus

List of Open Source Software: NIL