GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Chemical Engineering

Subject Code: DI04005041

Subject Name: Chemical Engineering Thermodynamics

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	PCC

Prerequisite:	Student should have knowledge regarding Basic Chemistry, Physics, Mathematics and Unit Operations.
Rationale:	Diploma Chemical engineer has to deal with the laws of thermodynamics which are applied to flow and non-flow processes in the plant to evaluate heat effects and energy transformation calculation accompanying physical and chemical changes, for calculating temperature change and to determine power generation efficiencies of engines and power plants. Understanding of basic concepts and application of thermodynamics are therefore necessary for chemical engineers. Hence the course has been designed to develop these competencies and its associated cognitive and effective domain learning outcomes.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Understand the fundamental concepts of thermodynamics	R,U,A
02	Apply the Concept of First Law of Thermodynamics for flow and non-flow processes.	R,U,A
03	Use the equation of state for ideal gas and real gas to predict PVT behavior of fluid.	U.A
04	Apply the Concept of second Law of Thermodynamics.	R,U,A
05	Apply the laws of thermodynamics in refrigeration	R,U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE(V)	
3	0	0	3	70	30	00	00	100

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
Unit– I Introduction and Basic Concept of Thermodynamics	**1.1** Scope and limitations of thermodynamics **1.2** System, surrounding, functions, properties and Process **1.2.1** System-Homogeneous and heterogeneous, Closed and Open, Isolated System, State of System **1.3** Properties -Extensive and intensive **1.4** Function -State and Path function **1.5** Process -Reversible and irreversible **1.6** Steady and Equilibrium State **1.7** Thermal, Chemical, Mechanical and thermodynamic equilibrium **1.8** Force, Pressure, Work, power and Energy **1.9** Gibb's Phase rule, degree of freedom **1.10** Zeroth Law of thermodynamics **1.11** Temperature **1.12** Ideal Gas Temperature Scale **1.13** Simple examples (numerical) on Force, Pressure, Work and Energy phase rule	09	18
Unit– II First Law of Thermodynamics	**2.1** First law of thermodynamics **2.2** Internal Energy, Enthalpy and Heat capacity **2.3** First law for non-flow processes and flow process **2.4** Numerical based on first law and energy - Internal Energy, Enthalpy and Heat capacity	7	18
Unit– III PVT Behavior	**3.1** PVT behavior of pure fluids with PV and PT diagram. **3.2** Ideal gas and equation of state **3.3** Ideal gas Process: **3.3.1** Constant Volume process **3.3.2** Constant Pressure process **3.3.3** Constant Temperature process **3.3.4** Adiabatic Process **3.3.5** Polytropic Process **3.4** Equation of state for real gases **3.4.1** Vander Waals Equation (brief discussion) **3.4.2** Virial Equation **3.4.3** Compressibility charts **3.5** Numerical based on Idea gas and real gas equations	10	22

Unit–IV Second Law Of Thermo-dynamics	**4.1** Limitations of first law of thermodynamics **4.2** Heat reservoir, Heat engine and Heat pump **4.3** General Statement of Second Law of Thermodynamics. **4.4** Concept of Entropy **4.5** The Carnot Principle **4.5.1** Thermodynamic temperature scale **4.5.2** Ideal Gas as the Carnot Engine Working Substance **4.6** Calculation of entropy changes during: **4.6.1** Phase change, **4.6.2** Ideal gas process **4.6.3** Adiabatic mixing process, **4.6.4** Isothermal mixing of ideal gases, **4.6.5** Chemical reaction **4.7** Clausius Inequality **4.8** Mathematical Statement of Second law of Thermodynamics **4.9** Numerical based on entropy change and heat engine efficiency **4.10** Explain the Statement of Third Law of thermodynamics	13	26
Unit– V Refrigeration Cycles and Systems	**5.1** Explain refrigeration, COP, Refrigerator capacity **5.2** Carnot Cycle, Vapor-compression cycle and Air- refrigeration cycle (only theory) **5.3** Types of refrigerants and codes **5.4** Choice of refrigerant **5.5** Numerical based on COP, Refrigerator Capacity	06	16
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
28	**36**	**36**	---------	————————	————————

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S.No.	Title of Book	Author	Publication with place, year and ISBN
1	A Textbook of Chemical Engineering Thermodynamics	Narayan,K.V.	PHI Learning PVT Ltd. New Delhi,2013, ISBN :9788120347472
2	Introduction to Chemical Engineering Thermodynamic	Smith J.M., Van Ness H.C., Abott M.M	McGraw-Hill, New York,1996 ISBN :978-9353168490
3	Chemical Engineering Thermodynamics–I	Gavhane, K.A.	Nirali Prakashan, Pune,2009
4	A Textbook of Engineering Thermodynamics	Rajput,R.K.	Publisher: Laxmi Publications, third edition 2007 ISBN 10: 813180058X ISBN 13: 978-8131800584
5	Introduction to CHEMICAL ENGINEERING THERMODYNAMICS	Halder,Gopinath	Publisher: PHI Learning; 2nd edition (2 September 2014) ISBN 10: 813180058X ISBN 13: 978-8120348974

(b) Open-source software and website:

1. https://onlinecourses.nptel.ac.in
2. https://learncheme.com/quiz-yourself/interactive-self-study-modules/
3. https://ocw.mit.edu/courses/10-40-chemical-engineering-thermodynamics-fall-2003/
4. https://open.umn.edu/opentextbooks/textbooks/1864
5. https://alison.com/course/basics-of-thermodynamics?

Suggested Activities for Students:

1. Prepare the presentation on various topics of thermodynamics
2. Practice various different free available thermodynamic simulation tools.
3. Prepare Chart/Poster on PVT diagram
4. Identify different refrigerants

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