

LOK JAGRUTI UNIVERSITY (LJU)
INSTITUTE OF ENGINEERING & TECHNOLOGY

Department of Chemical Engineering (708)
Bachelor of Engineering (B.E.) – Semester – II

Course Code:	017082201
Course Name:	Thermodynamics - I
Category of Course:	Engineering Science Course (ESC)
Prerequisite Course:	---

Teaching Scheme				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
4	1	0	5	50

Syllabus				
Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	Introduction to Thermodynamics			4 (8%)
	1.1 Definition of Thermodynamics	---	Thermodynamic Properties (2017083301-Unit-1.1)	
	1.2 Historical Background on Thermodynamics	---		
	1.3 Scope of Thermodynamics	---		
	1.4 Limitation of Thermodynamics	---		
	1.5 Application of Thermodynamics	Scope of Thermodynamics (017082201-Unit-1.3)		
	1.6 Microscopic Approach and Macroscopic Approach	---		
1.7 Definition of Thermodynamic System, Surrounding, Universe and Process	---			
02	Fundamental Concepts of Thermodynamics			5 (10%)
	2.1 Open System, Close System and Isolated System	Definition of Thermodynamic System (017082201-Unit-1.7)	Phase Rule for Non-reacting Systems and Duhem's Theorem (017083301-Unit-2.3)	
	2.2 Homogeneous Mixture and Heterogeneous Mixture	---		
	2.3 State of Thermodynamic System : Equilibrium State and Steady State	Microscopic Approach and Macroscopic Approach (017082201-Unit-1.6)		
	2.4 Property of Thermodynamic System : Intensive and Extensive	---		
	2.5 State Function and Path Function	---		
	2.6 Forms of Energy: Internal energy, Kinetic Energy and Potential Energy	---	Fundamental Property Relations (017083301-Unit-1.4)	
	2.7 Concept of Heat, Work, Heat Engine and Heat Pump	Forms of Energy (017082201-Unit-2.6)		
	2.8 Reversible Process and Irreversible Process	Definition of Thermodynamic Process (017082201-Unit-1.7)		
2.9 Gibb's Phase Rule for Non reacting System	State of Thermodynamic System (017082201-Unit-2.3)	Phase Rule for Reacting Systems (017083301-Unit-8.9)		
03	Zeroth Law of Thermodynamics			4 (8%)
	3.1 Zeroth law of Thermodynamics	State of Thermodynamic System (017082201-Unit-2.3)	Introduction to Heat Transfer (017083403-Unit-1.1)	
	3.2 Concept of Temperature	Zeroth law of Thermodynamics (017082201-Unit-3.1)		
	3.3 Temperature Scale	Concept of Temperature (017082201-Unit-3.2)		
3.4 Constant Volume Gas Thermometer	Temperature Scale (017082201-Unit-3.3)			
04	1st Law of Thermodynamics			5 (10%)
	4.1 Joule's Experiment	Concept of Heat and Work (017082201-Unit-2.7)	Natural Convection from Vertical and Horizontal Surfaces Under Laminar and Turbulent Conditions for Plates (017083403-Unit-4.2)	
	4.2 1 st Law of Thermodynamics	Joule's Experiment (017082201-Unit-4.1)		
	4.3 1 st Law of Thermodynamics for Cyclic Process	1 st Law of Thermodynamics (017082201-Unit-4.2)		
	4.4 1 st Law of Thermodynamics for Non Flow Process	1 st Law of Thermodynamics (017082201-Unit-4.2)		
	4.5 Energy balance for Non Flow process	1 st Law of Thermodynamics for Non-Flow Process (017082201-Unit-4.4)		
	4.6 Heat Capacity	---		
	4.7 Enthalpy	Forms of Energy (017082201-Unit-2.6)		
	4.8 1 st Law of Thermodynamics for Flow Process	1 st Law of Thermodynamics (017082201-Unit-4.2)		
4.9 Application to Steady State Flow Process	1 st Law of Thermodynamics for Flow Process (017082201-Unit-4.8)			
05	P-V-T Behavior of Pure Substance			5 (10%)
	5.1 Phase Diagram	---	Retrograde Condensation (017083301-Unit-4.6)	
	5.2 Critical Point and Supercritical Fluid	Phase Diagram (017082201-Unit-5.2)		

	5.3 Temperature – Volume Diagram	---		
	5.4 Pressure – Volume Diagram	---		
06	Equation of State			7 (14%)
	6.1 Ideal and Non-Ideal Gases	---	Raoul's Law and Ideal Solution (017083301-Unit-7.2)	
	6.2 Equation of State for Ideal Gases	Ideal and Non-Ideal Gases (017082201-Unit-6.1)		
	6.3 Process Involving Ideal Gas	Ideal and Non-Ideal Gases (017082201-Unit-6.1)		
	6.4 Equation of State for Real Gases	Ideal and Non-Ideal Gases (017082201-Unit-6.1)		
07	Heat Effects			5 (10%)
	7.1 Sensible Heat	Concept of Heat (017082201-Unit-2.7)	Equilibrium Constant and Standard Free Energy Change (017083301-Unit-8.3)	
	7.2 Latent Heat	---		
	7.3 Heat of Formation	---		
	7.4 Heat of Combustion	---		
	7.5 Heat of Reaction	---		
	7.6 Hess Law	Heat of Formation (017082201-Unit-7.3)		
08	Entropy Change			5 (10%)
	8.1 Concept of Entropy	---	Maxwell's Relations (017083301-Unit-1.5)	
	8.2 Calculation of Entropy change during Phase Change	Concept of Entropy (017082201-Unit-8.1)		
	8.3 Calculation of Entropy change during Process Involving Ideal Gas	Concept of Entropy (017082201-Unit-8.1)		
	8.4 Absolute Temperature scale of thermodynamic	Concept of Temperature (017082201-Unit-3.2)		
	8.5 Entropy : A State Function	Concept of Entropy (017082201-Unit-8.1)		
09	2nd Law of Thermodynamics and 3rd Law of Thermodynamics			6 (12%)
	9.1 Statements of Second Law of Thermodynamics	1 st Law of Thermodynamics (017082201-Unit-4.2)	Entropy Change of Mixing (017083301-Unit-6.2)	
	9.2 Thermal Energy Reservoirs	---		
	9.3 Heat Engines	Thermal Energy Reservoirs (017082201-Unit-9.2)		
	9.4 The Carnot Principles	Heat Engines (017082201-Unit-9.3)		
	9.5 Ideal Gas as Carnot Engine Working Substance	The Carnot Principles (017082201-Unit-9.4)		
	9.6 Equivalence of Second Law of Thermodynamics	Statements of Second Law of Thermodynamics (017082201-Unit-9.1)		
	9.7 Clausius Inequality	Statements of Second Law of Thermodynamics (017082201-Unit-9.1)		
	9.8 Application of Second Law of Thermodynamics	---		
	9.9 3 rd Law of Thermodynamics	Concept of Entropy (017082201-Unit-8.1)		
10	Refrigeration			4 (8%)
	10.1 Heat Pump	Concept of Heat and Work (017082201-Unit-2.7)	---	
	10.2 Carnot Refrigeration Cycle	The Carnot Principles (017082201-Unit-9.4)	---	
	10.3 Vapor Compression Cycle	---	---	
	10.4 Absorption Refrigeration	---	---	
	10.5 Choice of Refrigerant	---	---	

Proposed Theory + Practical Evaluation Scheme by Academicians
(% Weightage Category Wise and it's Marks Distribution)

L: 4 T: 1 P: 0

Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.
Each Test will be of 25 Marks.
Each Test Syllabus Weightage: Range should be 20% - 30%

Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage
Theory	5	5	MCQ	60%	60
Theory			Theory Descriptive	15%	15
Theory			Formulas and Derivation	10%	10
Theory			Numerical	15%	15
Expected Theory %			100%	Calculated Theory %	100%
Practical	0		Individual Project	0%	0
Practical			Group Project	0%	0
Practical			Internal Practical Evaluation (IPE)	0%	0
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	0%	Calculated Practical %	0%	0	
Overall %	100%			100%	100

Course Outcome

Upon completion of the course students will be able to

CO1	Understand fundamental concept of thermodynamic properties, work, heat, internal energy, enthalpy, state of thermodynamic system, zeroth law of thermodynamics and their applications.
CO2	Understand fundamental concept first law of thermodynamics and apply to different thermodynamic processes, also learn the phase diagram for pure substance with pressure, volume and temperature diagram.
CO3	Evaluate changes in different thermodynamic properties for pure fluids using equations of state and different heat effects.
CO4	Learn the concept of change in entropy, second law of thermodynamics, third law of thermodynamics and basics of refrigeration cycles.

Suggested Reference Books

1	A text book of Chemical Engineering Thermodynamics, K. V. Narayanan, Prentice-Hall of India Pvt. Ltd.
2	Introduction to Chemical Engineering Thermodynamics, J. M. Smith, H. C. Vanness, M. M. Abbott, The McGraw-Hill Companies, Inc.
3	Thermodynamics: An Engineering Approach, Yunus Cengel, Michael Boles, The McGraw-Hill Companies, Inc
4	Introduction to Thermodynamics, Y.V.C. Rao, Wiley Eastern Limited
5	Chemical and Process Thermodynamics, B.G. Kyle, Prentice-Hall Inc.

List of Open source software

1	https://nptel.ac.in
2	https://www.coursera.org/in