

BASIC THERMODYNAMICS

Course code	20ES1304	Year	II	Semester	I
Course category	Engineering Science	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

CO	Statement	Skill	BTL	Units
CO1	Understand the fundamental laws of thermodynamics, concept of reversibility, phase transformation of materials and various thermal cycles.	Understand	L2	1,2,3,4,5
CO2	Apply the energy conservation for closed and open cycle systems.	Apply	L3	1,2
CO3	Apply the directional law for various cyclic devices named as Heat Engine, Heat Pump and Refrigerator.	Apply	L3	2,3
CO4	Analyze availability and entropy of various perfect gas as well as phase transforming thermodynamic processes.	Analyze	L4	3,4
CO5	Analyze the performance of different thermodynamic cycles.	Analyze	L4	5
CO6	Analyze the given scenario, use appropriate techniques and write an effective report.	Analyze	L4	2,3,4,5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3												3	
CO2	3	2											3	
CO3	3	2				2						2	3	
CO4	3	2											3	
CO5	3	2				2						2	3	
CO6	3												3	

Syllabus

Unit	Contents	COs
I	Introduction: Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics. First Law of Thermodynamics (Closed System): Joule’s experiment - first law of thermodynamics, corollaries- perpetual motion machines of first kind, First law applied to non-flow process.	CO1, CO2
II	First Law of Thermodynamics (Open System): First law applied to flow process, Steady flow energy equation- limitations of first law of thermodynamics. Second Law of Thermodynamics: Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility	CO1, CO2, CO3, CO6
III	Engineering Devices: Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency. Entropy: Clausius inequality -Concept of Entropy- entropy equation for	CO1, CO3, CO4,

	different processes and systems, Maxwell relations, TdS equations.	CO6
IV	<p>Availability and Irreversibility: Definition of exergy and energy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes, irreversibility.</p> <p>Properties of Steam and Use of Steam Tables: Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry.</p>	CO1, CO4, CO6,
V	<p>Gas Power Cycles: Otto, Diesel, Dual Combustion cycles- Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.</p> <p>Thermodynamic Cycles: Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Brayton Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.</p>	CO1, CO5, CO6

Learning Resource	
Text books	
<ol style="list-style-type: none"> 1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013. 2. Yunus A. Cengel, Michael A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011. 	
Reference books	
<ol style="list-style-type: none"> 1. J.B.Jones and G.A.Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons, 2012. 2. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015 3. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009 4. R.K. Rajput, S.Chand & Co., Thermal Engineering, 6/e, Laxmi publications, 2010. 	
e- Resources & other digital material	
<ol style="list-style-type: none"> 1. https://nptel.ac.in/courses/112/105/112105266/ 2. https://nptel.ac.in/courses/103/103/103103144/ 3. https://nptel.ac.in/courses/112/105/112105220/ 4. https://nptel.ac.in/courses/101/104/101104067/ 5. https://nptel.ac.in/courses/101/104/101104063/ 6. https://nptel.ac.in/courses/103/104/103104151/ 	