

Branch Name:	Mechanical Engineering
Program Code:	ET101
Course Name:	Applied Thermodynamics
Course Code:	2ET1010301T
Pre-requisite Course:	Elements of Mechanical Engineering

Course Objectives:

1. To understand the concepts of Energy in general and Heat and Work in particular.
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To understand the fundamentals of quantification and grade of energy.
4. To apply the laws/concepts of thermodynamics to basic energy systems.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
04	03	01	-	04	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction and Basic Concepts: Application areas of thermodynamics, Macroscopic and Microscopic view points, Systems and Control volumes, Properties of system, Continuum, State and equilibrium, Processes and cycles, Quasi – static Process, Pure substance, Temperature and Zeroth law of thermodynamics, Heat and thermodynamic Concept of work. First Law of Thermodynamics: Statement, Heat and work calculations, Joules' experiment, Application of first law to flow systems, steady flow energy equation as applied to boiler, condenser, nozzle, turbine, compressor, pump, throttling process, Charging and discharging of tanks, Limitations of first law of thermodynamics, PMM-I.	10	20
2	Second Law of Thermodynamics: Statements and their equivalence, thermal energy reservoirs, concept of heat engine, refrigerator, heat pump and perpetual motion machines, Reversible and irreversible processes, Carnot cycle, Carnot theorem and its corollaries, Thermodynamic Temperature Scale. Entropy: Concept of entropy, Temperature-entropy plot, Clausius inequality theorem Principle of Increase of entropy, entropy balance, first and second law combined, entropy changes of an ideal gas during reversible processes (non-flow and flow).	08	20

3	Availability: Available and unavailable energy, Available energy (AE) referred to cycle and energy source, Availability in steady flow process, availability in non-flow process, Irreversibility, second law efficiency. Property Relations: Introduction to Maxwell relations, Clausius- Clapeyron equation, volume expansivity and isothermal compressibility, Mayer relation, Joule-Thomson coefficient.	08	20
4	Power Cycles: Vapor Power Cycles: Carnot vapor cycle, Rankine cycle, variables affecting efficiency of Rankine cycle, reheat cycle, Concept of Ideal regeneration, Regenerative cycle Gas Power Cycles: Air standard assumptions, Otto cycle, Diesel cycle, dual cycle, Stirling cycle, Ericsson cycle, Atkinson cycle, Brayton cycle.	12	30
5	Reactive Systems: Combustion, theoretical and actual combustion processes, enthalpy of formation and enthalpy of combustion, Adiabatic flame temperature, first law analysis of reactive system.	04	10

Reference Books:

1. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education.
2. Modern Engineering Thermodynamics by Robert T Balmer, ELSEVIER.
3. Thermodynamics by R K Rajput, Laxmi Publications.
4. Thermodynamics – An Engineering Approach by YunusCengel& Boles, McGraw-Hill Education
5. Fundamentals of Thermodynamics by Moran & Shapiro.
6. Thermodynamics by C P Arora, McGraw-Hill Education.

E-Resources:

1. <https://archive.nptel.ac.in/courses/112/105/112105123/>

Course Learning Outcomes (CLO):

CLO	Description	Bloom's Taxonomy Level
CLO1	Demonstrate understanding of basic concepts of thermodynamics.	1 Remembering 2 Understanding
CLO2	Differentiate between quality and quantity of energy, heat and work, enthalpy and entropy and apply fundamentals of first law of thermodynamics.	3 Applying 4 Analyze
CLO3	Able to do thermal analysis of thermodynamic systems based on second law of thermodynamics.	3 Applying 4 Analyze
CLO4	Understand concepts of availability and irreversibility.	2 Understanding
CLO5	Analyze basic power cycles.	4 Analyze 5 Evaluating
CLO6	Apply the laws of thermodynamics to various real life systems.	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	M		M			M						L	M	M
CLO2		H	M			M	M					L	M	L
CLO3	M	H	M	M		M	M					L	M	L
CLO4	H	M	M	M	M								M	
CLO5	H	L	M										L	
CLO6	M			M	H	M					L		H	

H: High, M: Medium, L: Low