BASIC THERMODYNAMICS

Course code	20ES1304	**Year**	II	**Semester**	I
Course category	Engineering Science Course	**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

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

Contribution of Course Outcomes towards achievement of Program Outcomes

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

Syllabus

Unit No	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.	**CO 1, CO 2,**
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	**CO 1, CO 2, CO 3, CO 6**
III	**ENGINEERING DEVICES:** Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency. **ENTROPY:** Clausius inequality -Concept of Entropy- entropy equation for different processes and systems, Maxwell relations, TdS equations.	**CO 1, CO 3, CO 4, CO 6,**

IV	**AVAILABILITY AND IRREVERSIBILITY**: Definition of exergy and energy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes, irreversibility. **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.	**CO 1, CO 4, CO 6,**
V	**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. **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.	**CO 1, CO 5, CO 6,**

Learning Resource
Text books:
1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013. **2.** Yunus A. Cengel, Michaela A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.
Reference books
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
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/