NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME301
Course Title:	Thermodynamics
Course Type:	Core
Year of introduction:	2023-24

L	T	Practical component				C
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Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	infer the basic concepts and laws related to thermodynamics,	(BL2)
2	determine properties of substances used in various systems,	(BL5)
3	apply the laws of thermodynamics for various processes,	(BL3)
4	analyse various thermodynamic cycles for related applications.	(BL4)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching Hours
Unit I	**Fundamental Concept and First Law of Thermodynamics** Basic Fundamentals, Thermodynamic system, properties, processes and cycles, Concept of continuum, Zeroth law and temperature measurement, Work interactions and Heat interactions, First law for a closed system undergoing a cycle and change of state, Steady flow energy equation and its applications.	**06**
Unit II	**Properties of Gas and Pure Substance** Revision of ideal gas concept and overview of non-flow processes such as constant pressure, constant volume, isothermal, isentropic and polytropic, Real gases and real gas mixtures, Various equation of state, compressibility charts, Properties of pure substance, P-V-T surface, Use of property tables and Mollier's chart to determine properties of steam.	**06**

Unit III	**Second Law of Thermodynamics and Entropy** Kelvin-Plank and Clausius' statements, Causes of irreversibility and entropy concept, Carnot's theorem and its corollary, Thermodynamic temperature scale, Statement of third law of thermodynamics, Clausius theorem, inequality of Clausius, Entropy changes for reversible and irreversible processes, principle of increase of entropy, Entropy generation in closed and open system, Second law efficiency.	**08**
Unit IV	**Thermodynamic Relations and Cycles** Maxwell's relations, Clausius-Claperayon equation, General equations for change in internal energy, enthalpy, entropy, difference and ratio of heat capacities, Joule Kelvin effect. Analysis of Carnot cycles, Rankine cycle, Otto, Diesel, Dual cycle, Brayton cycle, Reverse Carnot cycle and VCR cycle based on first and second law of thermodynamics. Methods for the improvement of cycle performance.	**10**

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/References:

1. Boles M.A., Cengel Y.A., Thermodynamics: An Engineering Approach, McGraw Hill Education
2. Moran M. J., Shapiro H.N., Fundamentals of Engineering Thermodynamics, John Wiley & Sons
3. Sonntag R. E., Borgnakke C., Introduction to Engineering Thermodynamics, John Wiley & Sons
4. Nag P. K., Engineering Thermodynamics, McGraw Hill Education

Suggested List of Tutorials:

1. First law of thermodynamics applied to close and open systems
2. Properties of ideal and real gas
3. Properties of pure substance
4. Second law of thermodynamics applied to various systems
5. Application of entropy principle to close and open systems.
6. Analysis of various thermodynamics cycles
7. Applications of performance improvement methods for thermodynamic cycles
8. Application of software tools for problem solving