SEMESTER S5

THERMODYNAMICS

Course Code	**PCMRT502**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. To understand basic concepts and laws of thermodynamics
2. Determine change in properties of pure substances during phase change processes

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Role of Thermodynamics and it's applications–Basic Concepts Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic System and Control Volume, Surrounding, Boundaries, Types of Systems, Universe, Thermodynamic properties, Process, Cycle, Thermodynamic Equilibrium, Quasi – static Process State, Point and Path function. Zeroth Law of Thermodynamics, Measurement of Temperature, reference Points, Temperature Scales.	11
2	Energy - Work - Pdv work and other types of work transfer, free expansion work, heat and heat capacity. Joule's Experiment- First law of Thermodynamics - First law applied to Non flow Process- Enthalpy- specific heats- PMM1, First law applied to Flow Process, Mass and Energy balance in simple steady flow process, Limitations of First Law.	11
3	Second Law of Thermodynamics, Thermal Reservoir, Heat Engine, Heat pump – Kelvin- Planck and Clausius Statements, Equivalence of two statements, Reversibility, Irreversible Process, Causes of Irreversibility, PMM2, Carnot's theorem and its corollaries, Absolute Thermodynamic Temperature scale. Clausius Inequality, Entropy- Entropy changes in various thermodynamic processes, principle of increase of entropy, Entropy	11

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	generation, Entropy and Disorder, isentropic process, Third law of thermodynamics.	
4	Pure Substances, Phase Transformations, Triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, Saturation pressure and Temperature, T-s, h-s diagrams or Mollier Charts, Dryness Fraction, Property calculations using steam tables. The ideal Gas Equation, Characteristic an Universal Gas constants, Deviations from ideal Gas Model: Equation of state of real substances, Vander Waals Equation of State, Compressibility factor, General Thermodynamic Relations– Helmholtz and Gibb's functions - Maxwell's Relations, Tds equations, Throttling process, Joule Thomson Coefficient.	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand basic concepts and laws of thermodynamics	**K2**
CO2	Conduct first law analysis of open and closed systems	**K3**
CO3	Determine entropy and availability changes associated with different processes	**K3**
CO4	Understand the application and limitations of different equations of state	**K2**
CO5	Determine change in properties of pure substances during phase change processes	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

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CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Thermodynamics	P. K. Nag	McGraw Hill	2013
2	Fundamentals of Engineering Thermodynamics	E. Rathakrishnan	PHI	2005
3	Thermodynamics an Engineering Approach	Y. A. Cengel and M. A. Boles	McGraw Hill	2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Engineering Thermodynamics	Moran J., Shapiro N. M.	Wiley	2006
2	Fundamentals of Thermodynamics	R. E. Sonntag and C. Borgnakke	Wiley	2009
3	Thermodynamics	Holman J. P.	McGraw Hill	2004
4	Engineering Thermodynamics	M. Achuthan	PHI	2004

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
2	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=sUDfpFD0xX4&list=PLD8E646BAB3366BC8&index=4
3	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=lvy8h-yWhRQ&list=PLD8E646BAB3366BC8&index=6
4	https://archive.nptel.ac.in/courses/112/106/112106310/ https://www.youtube.com/watch?v=QdnssaDSyZs&list=PLD8E646BAB3366BC8&index=14

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