CHEMICAL ENGINEERING THERMODYNAMICS-I

Course Code:15CH1102

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Course Outcomes:

On successful completion of the course, the student should be able to

CO 1 Discuss various thermodynamic processes.

CO 2 Apply cubic equation of state to evaluate thermodynamic property with or without experimental data.

CO 3 Recognize the need and state second law of thermodynamics. Analyze the second law from the study of heat engines.

CO 4 Apply first and second law of thermodynamics to specific processes viz., pipe flow, nozzles, expansion and compression.

CO 5 Compare and explain the different refrigeration and liquefaction processes and estimate the efficiency of the refrigeration system.

UNIT-I (10 Lectures)

INTRODUCTION:

The scope of thermodynamics, force, temperature, pressure, work, energy, heat.

THE FIRST LAW AND OTHER BASIC CONCEPTS:

Joule's Experiments, the first law of thermodynamics, thermodynamic state and path functions, enthalpy, the steady-state steady-flow process, equilibrium, the phase rule, the reversible process, heat capacity, constant-V and constant- P processes.

UNIT-II (10 Lectures)

VOLUMETRIC PROPERTIES OF PURE FLUIDS:

The PVT behavior of pure substances, viral equations, the ideal gas, the applications of the virial equations, second virial coefficients from potential functions. Cubic equations of state, determination of Equation-of-State Parameters (The van der Waals and Redlich-Kwong equations of state only) generalized correlations for gases, generalized correlations for liquids.

UNIT-III (10 Lectures)

THE SECOND LAW OF THERMODYNAMICS:

Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale.

ENTROPY:

Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, and entropy from the microscopic view point.

UNIT-IV (10 Lectures)

THERMODYNAMICS OF FLOW PROCESSES:

Principles of conservation of mass, entropy and energy for flow systems, analysis of expansion processes; turbines, throttling; compression processes –compressors and pumps.

REFRIGERATION AND LIQUEFACTION:

The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.

UNIT-V (10 Lectures)

THERMODYNAMIC PROPERTIES OF FLUIDS:

Property relations for homogeneous phases, residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties.

TEXT BOOK:

Smith J.M. and Van Ness H.C, *"Introduction to Chemical Engineering Thermodynamics"*, 7th Edition, Tata McGraw Hill, 2009.

REFERENCES:

1. Rao Y.V. C., *"Chemical Engineering Thermodynamics"*, University Press Ltd., 2001.
2. Narayanan K. V., *"Chemical Engineering Thermodynamics"*, PHI, 2000.
3. Kyle B.G., *"Chemical and Process Thermodynamics"*, 3rd Edition, Pearson, Prentice Hall, 1999.
4. Abbott M.M, Van Ness H.C. *"Thermodynamics with chemical applications"*, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, 2005.