CHEMICAL ENGINEERING
THERMODYNAMICS-I

Course Code: 13CH1102

Course Educational Objectives:
This course introduces the student the following aspects.

- The scope of Thermodynamics, phase rule.
- Heat and work calculations for closed and open systems.
- Laws of Thermodynamics and their applications.
- Pressure –Volume- Temperature behavior of pure substances, and relations among thermodynamics properties.
- Second law of thermodynamics, and heat engines.
- Various refrigeration and liquefaction procedures.

Course Outcomes:
After completion of this course the student would be able to

- Make heat and work calculations for closed and open systems.
- Make use of ideal gas law, cubic equations of state in deducing the molar volume of pure substances given the phase rule variables.
- Use the steam tables, Lee/ Kesler tables.
- Apply both first and second laws of Thermodynamics to decide whether a machine is practically operable or not.
- Estimate efficiency of engines, given the temperatures of the heat reservoirs and coefficient of performance of refrigeration system.

UNIT-I (13 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, virial 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 (14 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 viewpoint

UNIT-IV (15 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 (8 Lectures)
THERMODYNAMIC PROPERTIES OF FLUIDS:
Property relations for homogeneous phases, residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties.
TEXT BOOK:

REFERENCES: