

19PE212 PETROLEUM ENGINEERING THERMODYNAMICS

Hours Per Week :

L	T	P	C
3	1	-	4

Total Hours :

L	T	P	WA/RA	SSH/HSB	CS	SA	S	BS
45	15	-	25	50	-	-	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with first, second and third laws of thermodynamics, volumetric properties. The objective of this course is to provide understanding in the theory and applications of classical thermodynamics, thermodynamic properties and equations of state and methods used to describe and predict the vapor liquid equilibrium.

COURSE OUTCOMES :

Upon completion of the course, the student will be able to achieve the following outcomes :

COs	Course Outcomes	POs
1	Apply fundamental concepts of thermodynamics to engineering applications.	1, 2
2	Estimate thermodynamic properties of substances in gas and liquid states.	3
3	Derive and discuss the first and second laws of thermodynamics.	4
4	Apply laws of thermodynamics to engineering applications.	6
5	Solve problems using the properties and relationships of thermodynamic fluids.	3, 4
6	Compare various phase equilibrium such as LLE, VLE, SLE and SGE.	2

SKILLS:

- ✓ Estimation of thermodynamic properties.
- ✓ Determination of heat engine efficiency.
- ✓ Identification of reversible and irreversible processes.
- ✓ Describe the Process in terms of the changes in system properties.
- ✓ Estimation of solution thermodynamic properties.



SOURCE:
<https://www.cere.dtu.dk/research-and-projects/phd-projects/thermodynamics-of-petroleum-fluids-relevant-to-subsea-processing>

UNIT – I**L-9, T-3**

INTRODUCTION : The scope of thermodynamics; Defined quantities: temperature, volume, pressure, work, energy, heat, joules experiments, SI units.

THE FIRST LAW AND OTHER BASIC CONCEPTS : The first law of thermodynamics; Thermodynamic state and state functions; Enthalpy; The steady-state steady flow process; Equilibrium; The reversible process, constant-V and constant- P processes, heat capacity.

UNIT – II**L-9, T-3**

VOLUMETRIC PROPERTIES OF PURE FLUIDS : The PVT behavior of pure substances; Virial equations; the ideal gas, the applications of the virial equations; Cubic equations of state; Generalized correlations for gases.

UNIT – III**L-9, T-3**

THE SECOND LAW OF THERMODYNAMICS : Statements of the second law; Heat engines; Thermodynamic temperature 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.

UNIT – IV**L-9, T-3**

THERMODYNAMIC PROPERTIES OF FLUIDS : Property relations for homogeneous phases; Residual properties; Generalized property correlations for gases.

THERMODYNAMICS OF FLOW PROCESSES : Principles of conservation of mass and energy for flow systems; Analysis of expansion processes: turbines, throttling; compression processes: compressors and pumps; Calculation of ideal work and last work.

UNIT – V**L-9, T-3**

SOLUTION THERMODYNAMICS : Basic concepts of chemical potential and phase equilibria; Partial properties; Fugacity coefficient; Residual and excess Gibbs free energy; Correlations for the estimation of fugacity coefficient.

PHASE EQUILIBRIA : Introduction to Vapor-Liquid–Liquid-Equilibrium (VLLE), Solid-Liquid-Equilibrium (SLE) and Solid-Vapor-Equilibrium (SVE).

TEXT BOOKS:

1. Smith, J. M., H. C. Van Ness and M.M. Abbott, "Introduction to Chemical Engineering Thermodynamics", 6th edition, 8th reprint, McGraw Hill, 2006.
2. M. R. Riaze, ASTM, "Characterization and Properties of Petroleum Fractions", International, 2005.
3. Tarek Ahmed, "Equation of State and PVT analysis", 5th edition, Gulf publishing company, 2007.

REFERENCE BOOKS:

1. Koretsky, M.D., "Engineering and Chemical Thermodynamics", 2nd edition, John Wiley & Sons, 2004.
2. Richard Elliott, J and Carl T. Lira, "Introductory Chemical Engineering Thermodynamics", 2nd edition, Prentice Hall, 2012.
3. Stanley Sandler, "Chemical, Biochemical and Engineering Thermodynamics", 4th edition, Wiley India Pvt Ltd, 2006.
4. Vidal, J., "Thermodynamics: Applications in Chemical Engineering and the Petroleum Industry", Edition Technip, 2003.
5. Kyle, B. G., "Chemical and Process Thermodynamics", 3rd Edition, PHI Learning, 2008.