Teaching Scheme					Chemical Engineering Thermodynamics (22PCM205T)					
					Examination Scheme					
L	T	P	C	Hours/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To have a clear understanding of chemical engineering thermodynamics.
- To understand the basic laws of thermodynamics, processes cycles and their applications
- To understand the PVT relationship of pure gases and mixtures and their evaluation.
- To understand aspects of solution thermodynamics and mixing rules.
- To understand and predict vapour liquid equilibria based on Gibbs free energy models.
- To study the principles of chemical reaction equilibria and their application.

UNIT I: Thermodynamic law's and processes and their analysis 7 Hr.

Revisiting the laws of thermodynamics, statements of the second law of thermodynamics and their equivalence; Processes and cycles: Carnot's, Otto, Diesel, Rankine and Brayton cycles; Concept of entropy, criterion of irreversibility, calculation of entropy changes; Energy, refrigeration and liquefaction processes.

UNIT II: PVT relationship concepts and calculations 7 Hr.

Properties of pure substances and mixtures, cubic equations of state, Virial equation of state, compressibility factor, acentric factor; Property relationships, residual properties and their evaluation using equation of states.

UNIT III: Solution and equilibrium thermodynamics 7 Hr.

Partial molar properties; Chemical potential, activity and activity coefficients; Fugacity and fugacity coefficients in mixture; Ideal gas mixing models, entropy, enthalpy, free energy and volume change of mixing; Excess property of mixtures: Lewis Randall rule, Raoults law and Henry's law; Criteria for phase equilibrium: Vapour liquid equilibrium, modified Raoult's law and non-ideal mixtures; Excess Gibbs free energy models Margules, Van Laar, NRTL, etc.

UNIT IV: Chemical reaction equilibria 7 Hr.

Equilibrium criteria of chemical reaction, reaction coordinate, equilibrium constant, feasibility of chemical reactions and its relation to Gibbs free energy change; Homogeneous gas phase reaction equilibria: Effect of temperature, pressure, excess reactants and inerts on equilibrium conversion. Homogenous liquid phase reaction equilibria. Heterogeneous reaction equilibria.

Max: 28 Hr.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Understand the concepts of thermodynamic laws and processes.

CO2: Understand and apply the fundamental knowledge of pressure volume temperature relationships.

CO3: Analyse the concept of vapour liquid equilibria.
CO4: Introduce excess properties and Gibbs free energy change during reactions.
CO5: Evaluate the residual properties using equation of state and excess properties of mixtures.
CO6: Understand the reaction coordinate, reaction equilibria and factors influencing it.

TEXT/REFERENCE BOOKS

1. Smith, J.M., Van Ness, H.C. and Abbott, M.M. "Introduction to Chemical Engineering Thermodynamics", 8th Edition, McGraw-Hill India (2019).
2. Halder, G. "Introduction to Chemical Engineering Thermodynamics", PHI Learning Private Limited, New Delhi (2009).
3. Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill (1944).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hr.**
Part A: 10 Questions each carrying 5 marks	50 Marks
Part B: 5 Questions each carrying 10 marks	50 Marks