Course (Unit) Title	**Foundations of Physical Chemistry**
Course (Unit) Code	CHE102G2
Credit Value	02 (30 hours of lectures and tutorials)
Objective/s	• Provide students a clear understanding about some of the basic principles of Physical Chemistry, principles governing the equilibrium between phases and the laws of Thermodynamics and their applications
Intended Learning Outcomes	• Explain the ideal and non-ideal behaviour of gases and derive equations governing them • Outline the activity, partitioning and the fundamentals of chemical kinetics • Analyse the equilibria between different phases and the factors affecting them • Apply the laws of chemical thermodynamics to different situations including chemical equilibria and phase equilibria under different conditions • Describe some of the thermodynamic properties in terms of the atomic and molecular properties in a fundamental way
Contents	**Introductory Physical Chemistry and Phase Equilibria** • Molecular kinetic theory of gases, energies of gas molecules, interpretation of gas properties, non-ideal behaviour, van der Waals equation, other equations of state, Maxwell distribution and its applications, collision frequency, collision number, mean free path, condensation, critical constants, reduced equation of state, activity and activity coefficients, partition coefficient and its applications (excluding extraction) • Chemical kinetics: rate, rate law, order and molecularity, zero order and first order reactions, influence of temperature, method of initial rates • Phase equilibria: phase, number of components, number of degrees of freedom, phase rule, phase diagram of one component systems • Two component liquid-liquid and liquid-vapour equilibria: Raoult's law and ideal behaviour, phase diagram for ideal behaviour, Lever rule, fractional distillation, azeotropes, immiscible liquids, steam distillation, partially soluble liquids

	• Two component solid-liquid equilibria: eutectics, systems with congruent and incongruent melting points, cooling curves, partial and total solid solubility, three components systems **Chemical Thermodynamics** • Work, heat, reversible and irreversible expansions, isothermal and adiabatic processes, state functions and exact differentials, zeroth and first laws of thermodynamics, internal energy, molecular nature of internal energy, heat capacities (Cp and Cv), Joule-Thomson effect, variation of specific heat with temperature, thermo chemistry, standard thermodynamic functions and reactions, Kirchhoff's law • Second law of thermodynamics, entropy and reversibility, molecular interpretation of entropy, free energy functions, Clapeyron equation, Clausius-Clapeyron equation, van't Hoff equation, isochoric reaction, relationship between change in Gibbs free energy and equilibrium constant, variation of equilibrium constant with temperature, Maxwell relationships and their applications, open systems, Gibbs-Helmholtz and related equations, partial molar properties, chemical potentials and their variation with temperature and pressure, chemical potentials of solvents in ideal solutions, Gibbs-Duhem equation, third law of thermodynamics, absolute entropies • Introduction to statistical thermodynamics: Ensemble, distributions and number of complexions, most probable distribution, expressions for total energy, entropy and free energy
Teaching and Learning Methods / Activities	Lectures, Tutorials and Assignments
Evaluation	In-course Assessments 30% End of Course Examination 70%
Recommended References	• Atkins, P. and de Paula, *J. Elements of Physical Chemistry*, 11th edition, Oxford: Oxford University Press, 2017. • Levine, I. N., *Physical Chemistry*, 6th edition, New York: McGraw Hill, 2009. • Price, G., *Thermodynamics of Chemical Processes*, Oxford: Oxford University Press, 1998. • Seddon, J. M. and Gale, J. D., *Thermodynamics and Statistical Mechanics*, Cambridge: Royal Society of Chemistry, 2002.