Course Title:	**Properties of gases and liquids**
Lecturer:	Prof. Marko Rogošić, Ph.D.
Course Type:	Elective
ECTS:	6
Total Hours:	30 hours
Content of the Course:	The course provides an overview of the methods for estimation of thermodynamic and transport properties of liquids and gases with a special emphasis on the methods frequently applied in the petroleum and petrochemical industry.
Competences:	Having completed the course, students will know the basics of methods applied in estimation of the thermodynamic and transport properties of liquids and gases and will be able to select adequate methods to be applied to specific industrial problems, during their practice of using chemical engineering software.
Teaching Methodology:	Lectures (potentially seminars)
Course Units:	Introduction: general information on the estimation of properties; the principle of corresponding states, non-polar and polar molecules, the structure of molecules and chemical bonds. Estimation of pure substance constants: critical properties, Pitzer acentric factor, boiling point and melting point. Thermodynamic properties of ideal gases: Gibbs energy, enthalpy and entropy of formation, heat capacities, enthalpy of combustion. ,Pressure-volume-temperature correlations of pure substances: the principle of corresponding states, equations of state , virial e.s., analytical e.s.; non-analytical e.s.; *pvT* properties of liquids. Pressure-volume-temperature correlationsof mixtures: properties of mixtures and solutions, the principle of corresponding states, equations of state, virial e.s., analytical e.s.; non-analytical e.s.; *pvT* properties of liquids. Thermodynamic properties of real pure substances,mixtures and solutions: departure functions, heat capacity of gases and liquids, partial molar quantities and partial fugacity. Vapour pressures and enthalpies of evaporation of pure substances: correlation and extrapolation of experimental data for vapour pressures, enthalpies of evaporation from vapour pressures, enthalpies of evaporation based on the principle of corresponding states. Phase equilibrium in multi-component systems: thermodynamic basics, fugacity of liquids, activity coefficient, activity coefficient models, calculation of vapour-liquid phase equilibria under low pressures, multi-component systems, determination of the activity coefficients, Henry's law, phase equilibria using equations of state, "chemical theory", solubility of gases, liquid-liquid equilibria, solubility of solids in liquids, polymer solutions, electrolyte solutions. Viscosity: theoretical fundamentals of gas viscosity, gas viscosity at low pressures, viscosity of gaseous mixtures at low pressures, effect of pressure on gas viscosity, viscosity of gaseous mixtures at high pressures, viscosity of liquids, effect of pressure and temperature on liquid viscosity, viscosity of liquids at high temperatures, viscosity of liquid mixtures. Heat conductivity: theoretical fundamentals of heat conductivity, heat conductivity of multi-atomic gases, effect of temperature and pressure on heat conductivity, heat conductivity of gaseous mixtures, heat conductivity of liquids, effect of temperature on heat conductivity of liquids, heat conductivity of liquid mixtures. Diffusion coefficients: basic concepts and definitions, two-component gaseous mixtures – theory and empirical correlations, effect of pressure and temperature, multi-component gaseous mixtures, theory of diffusion in liquids, two component liquid mixtures, effect of concentration, pressure and temperature, multi-component liquid mixtures, electrolytes.
Examination method:	Written exam, seminar
References:	1. B.E. Poling, J.M. Prausnitz, J.P. O'Connell, The Properties of Gases and Liquids, 5th Ed., McGraw-Hill, New York, 2000. 2. S.I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th ed., Wiley, New York, 2006.
Course in English:	Yes
Quality Monitoring Method:	Course quality and performance monitoring in accordance with the quality management system of the University of Zagreb. Self-evaluation of lecturers and student poll.