Course Title	Mass and Energy Balance				
Course Code	OG300				
Course Type	Compulsory				
Level	BSc Level				
Year / Semester	3rd year / 5th semester				
Teacher's Name	Dr.-Ing. Paris A. Fokaides				
ECTS	6	Lectures / week	2	Laboratories/week	1
Course Purpose	The industry of oil and gas depends on successful operation of industries that require and consume raw materials and energy. This success depends, in turn, on efficient use of the available resources, which not only allows industry to conserve materials and energy, but also allows it to compete successfully in the world markets that exist today. The theory of the construction of material and energy balances, from which such knowledge is derived, is not particularly complicated or difficult, but the practice, particularly in the oil and gas processing operations, can be extremely difficult and expensive. In this course the basic principles of physical chemistry, linear algebra, and statistics, which are required to enable the practicing engineer to determine material and energy balances is presented. Some computational techniques, are also presented.				
Learning Outcomes	1. Implement material balances in oil and gas related processes without reaction (physical separation) 2. Calculate material balances in oil and gas related processes in reactive flows and mixtures 3. Solve material balances for multi-systems 4. Describe the ideal and real gas law and perform relevant calculations 5. Outline the principles of Enthalpy of reactions and its application to common problems 6. Implement energy balances with or without reaction for common oil and gas related applications 7. Reproduce the principles of humidity charts and interpret how they can be used for useful calculations				
Prerequisites	ME 200 Thermodynamics I ME 202 Fluid Mechanics I	Corequisites			
Course Content	**1. Thermophysical and related properties of materials** - Density, composition and concentration - The Gibbs phase rule - Vapour-liquid equilibrium				

	− Properties of solutions **2. Fundamentals of material balances in non-reacting systems** − The general balance equation − Material balances on non-reacting systems − Degree-of-freedom analysis − Continuous-mixing devices **3. Reactive Material Balances** − Writing and balancing chemical equations − Progress of a reaction − The general material balance procedure for a reactive system − Combustion material balances **4. Energy Balances in non-reacting systems** − First law of thermodynamics for open systems − Thermodynamic databases for pure substances − Combined material and heat balances − Multiple-device system balances **5. Mass and Energy Balance Laboratory Exercises** Laboratory Exercise 1: Sankey Diagrams using e-Sankey software – Energy mix analysis Laboratory Exercise 2: Sankey Diagrams using e-Sankey software – Nonreacting system mass balance Laboratory Exercise 3: Aspen Plus – Real gas properties Laboratory Exercise 4: Aspen Plus – Mixers and splitters
Teaching Methodology	The teaching methodology of this course will be based on lecturing, demonstrating and collaborating. - Lecture notes, comprising of the fundamentals of each module of the course will be prepared and presented in class on a weekly basis. The notes will introduce the major concepts and will focus on specific learning outcomes of the course. - Demonstration activities including the solution of worked examples in class on a weekly basis, as well as laboratorial work will also be employed. For each fundamental concept, at least one worked example will be solved during lectures. The laboratory work will cover all major topics of the course, allowing the students to personally relate to the presented knowledge. - Collaborating teaching through classroom discussion and debriefing will also be encouraged during lectures. Besides from the notes taken by students in class, all of the course material will be made available through the class website and also through the eLearning platform. The instructor will also be available to students during office hours or by appointment in order to provide any necessary tutoring.

Bibliography	Textbooks: Morris, A. E., Fine, H. A., & Geiger, G. (2011). Handbook on Material and Energy Balance Calculations in Material Processing, Includes CD-ROM. John Wiley & Sons Finlayson, B. A. (2012). Introduction to chemical engineering computing. John Wiley & Sons. References: D.M.Himmelblau and J.B. Riggs, "Basic Principles and Calculations in Chemical Engineering" Prentice Hall, 8th Edition
Assessment	Students will be assessed through: - An assignment related to the laboratory exercises - A midterm test at the 7th week of the course, examining the thermophysical and related properties of materials and the fundamentals of material balances in non-reacting systems - A final test at the end of the semester, in which all material will be examined. The weights of the course assessment are as follows: Assignment: 20% Midterm Exams: 20% Final Exams: 60%
Language	English