Course offered for the PhD program
in Civil, Chemical and Environmental Engineering
Curriculum in Chemical, Material and Process Engineering – a.a. 2013/2014
(XXX ciclo)

(possibility of participation for students in other PhD cycles or other PhD courses)

1. Title
THERMODYNAMICS OF OPEN SYSTEMS

2. Course Description
Thermodynamics of open or variable-composition systems with reference to the specifics of ideal systems and environmental applications.
PROGRAM
First and second laws of thermodynamics (summary).Thermodynamic functions and chemical potential. Gibbs-Duhem equation. Molar, partial molar and mixing properties. Phase and reaction equilibrium criteria in terms of extensive and intensive properties. The phase rule and Duhem variance. Ideal solutions. Phase equilibrium for ideal binary systems. Subcritical and supercritical components: Raoult and Henry laws. Phase equilibrium diagrams for ideal binary systems and their deviations. Equilibrium in reacting systems. Thermodynamic properties for ideal systems. Some environmental applications.

BIBLIOGRAPHY:

1. K. G. DENBIGH, The principles of chemical equilibrium, Fourth Ed., Cambridge University Press, New York, 1981.
2. PRAUSNITZ, J.M., LICHTENTHALER, R.N., de AZEVEDO, E.G.: *Molecular Thermodynamics of fluid-phase equilibria*, III ed., Prentice Hall, New Jersey, 1999.
3. PRAUSNITZ, J.M., POLING, B.E., O'CONNELL, J.P.: *The properties of gases and liquids*, V ed., Mc Graw Hill, New York, 2000.
4. PERRY, D. GREEN, *Perry's chemical engineers' handbook*, VIII ed., Mc Graw Hill, 2008.

3. Course Organization
The course includes frontal lessons (14 hours) and tutorials (4 hours). The course will be held in English if foreign students will be present.

4. Teacher
Elisabetta Arato

5. Duration and credits
18 h (weekly classes of three hours each) and 4 credits

6. Activation mode and teaching period
Biennial course
DATE OF THE COURSE: end of SEPTEMBER 2016
ENROLLMENT INSTRUCTIONS: e-mail: elisabetta.arato@unige.it including information on the scientific background of students

7. Deadline for registration
Within 10th September 2016

8. Final exam
Oral examination at the end of the course or later