**PRINCIPLES OF ENVIRONMENTAL ENGINEERING**

Prof. Agostina Chiavola

**Program**

Stoichiometry and kinetic of chemical reactions. Reaction order and its determination. Influence of temperature on the reaction rate. Mass balances. (10h)

Reactors. Ideal isotherm reactors (batch, CFSTR, PFR). Analysis of the response of CFSTR and PFR under both dynamic and steady-state conditions, to step and pulse signals. Analysis of series of CFSTR e PFR. Effect of the recycle on PFR and CFSTR. Comparisons of efficiency. Variable volume reactors (equalization). (20h)

Characterization parameters of environmental compartments. Biochemical Oxygen Demand (BOD) Application of Thomas and differential methods. Chemical Oxygen Demand (COD). Nitrogen. Phosphorous. Solids. (20h)

Biochemical kinetics. Microbial species characterization. Metabolism. Bacterial growth. Biochemical kinetic equations. Michaelis-Menten equation. Rate and specific rate of growth. Monod equation. Substrate and microorganism mass balance to suspended biomass CFSTR with and without sludge recycle, and with sludge waste from reactor and recycle loop. Average sludge age. Minimum sludge age. Hydraulic residence time. Organic and volumetric loading factors. Oxygen requirements. (30h)

Nitrification. (30h)

Unit operations. Settlement of type I, II, III and IV. Solid Flux theory. Adsorption. Coagulation-flocculation. Ion exchange. (10)

**Teaching methods**

The course consists of both theory classes and numerical exercise classes.

Schedule of the course (to be possibly modified underway):

* Theory classes:

Wednesday 12:00-2:00 pm: in person on line

Thursday 9:00-11:00: offline (recorded)

* Numerical exercise classes:

Friday 11:00-1:00 pm: in person on line

Friday 2:00-4:00 pm: offline (recorded)

**Study materials**

Audio lessons in Google classroom (access code: 4xxbm5y).

Pdf slides in the Moodle platform.

Books:

* L. D. Benefield, J. F. Judkins, B. L., Weand, Process chemistry for water and wastewater treatment, Prentice Hall, Inc., USA.
* R. E. Treybal, Mass transfer operations, McGraw-Hill, Inc., USA.