

IPL SUMMER SCHOOL 2019

Science and Engineering

June 13 to July 17

The CPE Lyon part of the IPL International Summer School includes a 5-week programme of **practical classes in chemistry and chemical engineering** (45 hours) in addition to taking the French language classes (39 hours) and the industrial and cultural visits. The **practical classes** are designed to allow students to transfer credits for the study to their home university (6 ECTS for the scientific courses and 3 ECTS for French classes). Experiments are offered in **Chemical Engineering** and **Analytical Chemistry**. Some experiments will be open-ended allowing students to go deeper into the particular aspect of the subject concerned. **The laboratory experiments offered are given on the following pages.** This is a tremendous opportunity to gain an international experience, to improve your scientific knowledge and practical skills, and to learn French language. The practical classes will be given in English.

Discover what Christian, from North Carolina University, thought of his experience in Lyon last summer.

“Where to start ! I had such a great summer! The CPE course material was extremely applicable to my chemical engineering major and was a great way to explore technical chemical processes from an applied standpoint that I had learned theoretically in my home university's classroom. The facilities available at CPE are top notch and combined with the company tours provide an in depth look at industrial processing equipment. The city and surrounding area was a fantastic place to explore and learn. The program pairs you with a French buddy that will help you get acquainted with the culture all while having a ton of fun visiting surrounding cities or exploring Lyon. I ended up becoming best friends with my buddy and we had a ton of fun throughout the program!”

For more information:

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Applications and deadline:

On IPL Summer School's [website](http://www.iplsummerschool.com), before April 12th 2019

To get updates about our program, follow us on [Facebook](https://www.facebook.com/iplsummerschool) !

<p>Introduction course</p>	<p>Course on “Chemical risk”, labeling, MSDS, toxicity and safety behavior in the laboratory</p>
<p>Experiment 1</p> <p>Head of loss (To determine the general expression for pressure drop in a linear tube)</p>	<p>Objective: This experiment will allow you to study pressure drop through different pipes fed with water.</p> <p>In an experimental part, you will measure pressure in the entrance pipe and the exit pipe at different flow rates to get pressure drop.</p> <p>In a calculation part, you will apply the non-dimensional analysis, a simple method fairly accurate for a wide variety of compounds, flow-rates and pipes.</p> <ul style="list-style-type: none"> • Measure the pressure drop in smooth linear tubes of different diameters using the appropriate manometers for different flow rates • Determine the two non-dimensional numbers, Reynolds number and Pressure Drop Coefficient, characteristic of fluid flow • Point the data obtained on a Moody chart. Discuss about these results and this predictive method • Carry out the same study using a rough sided tube. Use the moody chart to estimate the roughness
<p>Experiment 2</p> <p>Ebulliometry</p> <p>Liquid-vapor equilibrium</p>	<p>Objective: This experiment will allow you to illustrate liquid-vapor equilibria.</p> <p>In an experimental part, you will work on an ebulliometer to find experimental datas (T, x,y) at atmospheric pressure or low pressure.</p> <p>In a calculation part, from data to be found in the literature, you will be able to compute activity coefficients and adjust the parameters of Wilson’s excess model for the binary system considered.</p> <ul style="list-style-type: none"> • Get data (T,x,y) for the liquid-vapor equilibrium of the binary water-methanol mixture with an ebulliometric experiment • Using experimental data (T,x,y), and the equilibrium criterion : $f_i^l(T,P,x) = f_i^v(T,P,y)$, calculate the activity coefficients of water and methanol over the whole composition range • From these coefficient values ,estimate the infinite dilution activity coefficient γ_i^∞ • Using this information, calculate the parameters of Wilson’s excess model • Verify its validity for the binary system considered

<p>Experiment 3</p> <p>Quantification of polyaromatic hydrocarbons by UV spectroscopy</p>	<p>Spectrum, calibration curve, dilution of the sample. Sensitivity of the method. Results expressed in different units.</p> <p>Quantification of polyaromatic hydrocarbons by UV spectroscopy Spectrum measurement, construction of the calibration curve, dilution of the sample in order to predict the analyte concentration using the calibration curve. Sensitivity of the method. Results expressed in different units (mg/l, mol/L, ppm).</p>
<p>Experiment 4</p> <p>Chemical analysis of water for quality control</p>	<p><u>Determination of main parameters in drinking water:</u></p> <ul style="list-style-type: none"> • Determination of pH and alkalinity (pHmetric titration); HCO_3^- • Hardness : Ca^{2+} and Mg^{2+} (automatic titrator and calcium selective electrode) , • Conductivity, • Flame photometry for the determination of Na^+ and K^+ • Ionic chromatography for Cl^- , NO_3^- , SO_4^{--} <p><u>Synthesis of all the results:</u> Control of the ionic balance. Comparison of mineralization determined by addition of the values determined by each specific method, global approach by conductivity and dry residue.</p> <p>Conclusion about drinkability or not of the sample.</p>
<p>Experiment 5</p> <p>Distillation of the binary water-methanol mixture at atmospheric pressure</p>	<ul style="list-style-type: none"> • How to start the column and to choose parameters? • Determination of the number of trays in total reflux • Material and thermal balance • Distillation of the binary mixture, respecting the specifications. • optimize the separation of a methanol/water mixture by distillation to reach the purities required while minimizing energy expenditure
<p>Experiment 6 and 8</p> <p>Kinetics (Aldehyde oxidation + Saponification)</p>	<p>This practical involves 2 days in the laboratory for practical work and calculations.</p> <p>1st day: kinetics study of the oxidation of different aldehydes (the reactions will be followed by acid quantification and GC analyses).</p> <p>Ref: L. Vanoye, A. Favre-Réguillon, A. Aloui, R. Philippe and C. De Bellefon, Insights in the aerobic oxidation of aldehydes, <i>RSC Advances</i>, 2013, 3, 18931</p> <p>2nd day: in order to prepare the scale-up of a saponification reaction (project),</p>

	<p>students will study the kinetics of the reaction in a laboratory scale: use of quantitative GC analysis of the reaction medium to follow the conversion and to determine the kinetics parameters (global order, kinetic constant, activation energy) of the reaction.</p> <p>Calculations will be carried out for the scale-up of the reaction to a 5L-reactor.</p>
<p>Experiment 7</p> <p>Agitation practical</p> <p>(Stirring. The determination of the relationship between the power number N_p and the Reynolds number Re)</p>	<p>Objective: The measurements carried out on this pilot stirrer allow the relationship linking the power number N_p to the Reynolds number Re to be determined.</p> <p>It can be deduced that certain impellers are much more 'energy consuming' than others and that, depending on the phenomenon that one wishes to favorize, it is better to choose one type of impeller rather than another. This also allows one to optimize energy consumption.</p> <ul style="list-style-type: none"> • Establish a protocol that will enable the measurement of the power number N_p to be made as a function of the Reynolds number. • Choose two sizes from the large groups of impellers provided (Rushton turbine or marine propeller). For each impeller, observe the behaviour of the fluid within the stirred tank for different values of speed. Measure the different values of power, speed and torque to determine the two non-dimensional numbers (Reynolds number and power number N_p). What conclusions can you make?
<p>Experiment 9</p> <p>Precipitation and filtration of adipic acid</p>	<ul style="list-style-type: none"> • Prepare an aqueous solution of adipic acid • Precipitation by adding sulphuric acid • Put the mixture in a filtration cell • perform the filtration at a constant pressure • Determine the resistance of the cake and of the support using the filtration law and experimental values. • Is the column well sized? • Compare a precipitation and a crystallization • Purify industrially a solid
<p>Experiment 10</p> <p>Project</p>	<p>The aim of this project is to study the kinetics of a saponification reaction in the laboratory scale and then to calculate and design the scale-up of the reaction to a 5L reactor. This project is designed to help students become aware of the interconnection of the different chemistry domains. The objective is to successfully define the problem and the solutions of the scale-up of a chemical reaction.</p>