**CHEG 472: HOMEWORK 3**

**NOTE: SUBMIT THE LINK TO YOUR DEVELOPED APP By Sunday 3PM**

**Question 1**

In wastewater treatment, oxygen is supplied to support biological processes in an aeration tank. The oxygen transfer rate (OTR) is crucial for maintaining sufficient dissolved oxygen (DO) levels to meet biological oxygen demand (BOD).

Develop a python-based iterative app for a common problem in wastewater treatment: calculating the oxygen transfer rate (OTR) in an aeration tank. This process involves iteratively calculating the dissolved oxygen (DO) levels based on oxygen transfer and consumption rates.

This app will:

* Simulate the dissolved oxygen (DO) profile over time in the aeration tank.
* Iteratively calculate DO levels using the oxygen transfer and consumption rates.
* Allow users to adjust parameters such as oxygen transfer efficiency (OTE), oxygen consumption rate, and initial DO.
* Plot the DO concentration over time.

**Question 2**

Liquid – Liquid extraction is useful in the separation of compounds based on their different solubilities in two immiscible liquids. Develop a python-based calculator for a liquid-liquid extraction process, which is a common separation technique in chemical engineering. The app will calculate the equilibrium compositions of two immiscible phases and plot the distribution curve (also known as the tie-line diagram) for a ternary liquid-liquid system.

The app will:

* Calculate the distribution ratio (D) of a solute between two immiscible solvents.
* Use a distribution curve to visualize the relationship between the solute concentration in the two phases.
* Plot a tie-line diagram, showing the equilibrium compositions in both phases across different initial solute concentrations.

**Question 3**

Distillation is a key separation technique used in chemical engineering to separate liquid mixtures based on differences in their volatilities. Develop a Python-based calculator for the design and performance evaluation of a distillation column. This app will calculate the number of theoretical stages required for separating a binary mixture using the McCabe-Thiele method and plot the corresponding equilibrium curve.

The app will:

* Calculate the minimum number of stages required for the separation of a binary mixture given the feed composition, reflux ratio, and product specifications.
* Plot the equilibrium curve and operating lines (rectifying and stripping sections) on an x-y diagram, showing the relationship between the liquid and vapor compositions in the distillation column.
* Draw the McCabe-Thiele diagram to visualize the number of theoretical stages and the stepping process between equilibrium and operating lines.

**Question 4**

Chemical reactors are central to chemical engineering processes, where chemical reactions occur under controlled conditions. Develop a Python-based calculator for designing an isothermal Continuous Stirred Tank Reactor (CSTR) and a Plug Flow Reactor (PFR) for a first-order irreversible reaction. This app will calculate the reactor volume required to achieve a specified conversion and compare the performance of CSTR and PFR reactors.

The app will:

* Calculate the reactor volume (V) for both CSTR and PFR given the feed rate, rate constant, and target conversion.
* Compare the performance of CSTR and PFR, showing the volume required to achieve the same conversion in both reactors.
* Plot the conversion profile for a PFR along the reactor length and the conversion as a function of reactor volume for the CSTR.
* Allow the user to input reaction rate constants, flow rates, and initial concentrations, and dynamically adjust the conversion and reactor volumes.