# CHEM-E7190/2022: Exercise II - Linearization + simulation (Euler)

Task 1.

A jacketed vessel is used to cool a process stream. The following information is available:

1. The volume of coolant in the jacket V_J remain constant. Volumetric flow rate q_F and q_J vary with time.

2. Heat losses from the jacketed vessel are negligible.

3. Both the tank contents and the jacket contents are well mixed and have significant thermal capacitances.

4. The thermal capacitances of the tank wall and the jacket wall are negligible.

5. The overall heat transfer coefficient for transfer between the tank liquid and the coolant varies with coolant flow rate:

$U = K q_J^{0.8}$
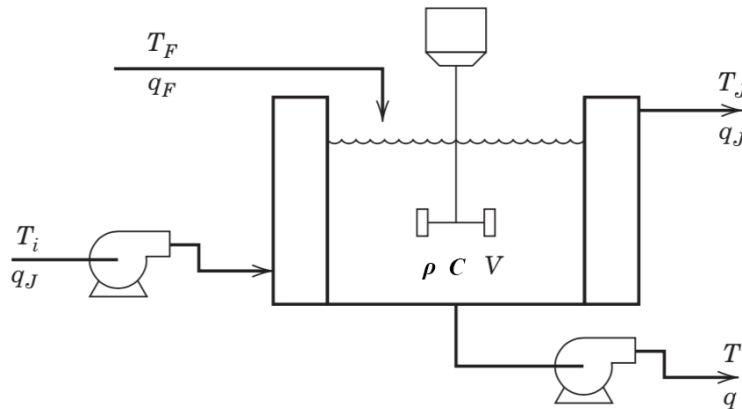
Additional assumptions:

1. Density of the liquid, ρ, and density of the coolant, ρ_J are constant.

2. Specific heat of the liquid, C, and of the coolant, C_J, are constant.

Use the jacketed vessel model that you developed in Exercise 1.

0. Verify that the given model equations are correct;

1. Write a script (with model function) to simulate the reactor for different initial conditions and inputs;

2. Choose $K = 1$, $\rho = 1$, $C = 1$, $A = 1$, $\rho_J = 1$, $V_j = 1$ and $C_J = 1$ for the model parameters, reasonable values for the initial conditions $(T(0), T_J(0), V(0))$ and the inputs $(q_J(t), T_F(t), T_i(t), q_F(t), q(t))$, for $0 \leq t \leq t_f$ and test your implementation. To verify/demonstrate the correctness of your implementation, display the evolution of all model variables.

3. For the chosen model parameters, define a set of operating conditions $(q_J^{SS}, T_F^{SS}, T_i^{SS}, q_F^{SS}, q^{SS})$ of your choice to run the reactor and find the corresponding steady-states $(T^{SS}, T_J^{SS}, V^{SS})$ by simulating the process for a sufficiently long tine.

4. Linearise the model around that steady-state and implement the linearised model and compare its evolution with the nonlinear one under the same conditions defined in (2.). Define your model as A, B and C matrices. Do not forget to verify the correctness of the linearised model above and plot the temporal evolution of all the involved process variables, to show the correctness of your code. Familiarise with programs `jacketedVesselmain_template_lin.m` and `jacketedVessel_template_lin.m`. You can use them as a template.