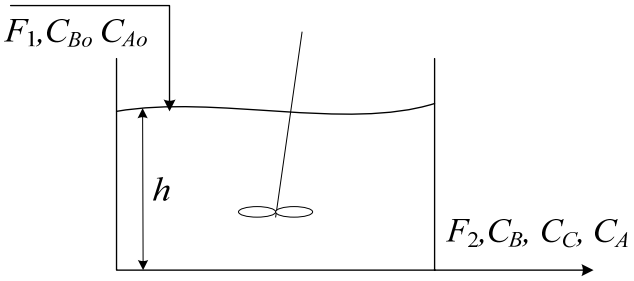
King Saud University
College of Engineering
Chemical Engineering Department

CHE 323 Exam I **120 minutes**

Q1. Consider the process shown in Figure below. A volumetric flow rate F_1 (m^3/s) with concentration C_{Ao} and C_{Bo} (mole/m^3) is fed to liquid phase reactor. Assume constant fluid properties, constant volume and isothermal operation. A chemical reaction of the form A + B → C takes place with a reaction rate $r = kC_A$. Note that the unit of k is 1/s.

(a) Write the model equations for the process.
(b) If the total outlet and inlet flow rates are given in mole/s and that the components are measured by their mole fractions, rewrite the model equations.



Q2. Given the following model equation:

$$n\frac{dy(t)}{dt} = Fy_i(t) - Fy(t) - kny(t); \qquad y(0) = 0$$

Using Laplace Transform solve the above equation to show how the mole fraction, y, changes with time for a step change in the feed mole fraction, y_i. Sketch your result.

Q3. Using $F(s) = \int_0^\infty f(t)e^{-st}dt$ find the Laplace transform of the following function:

$$f(t) = e^{-at}\sin\omega t$$

Useful Data:

$$\sin\omega t = \frac{e^{i\omega t} - e^{-i\omega t}}{2i}$$

F(t)	F(s)
1	$1/s$
e^{-at}	$1/(s+a)$