# Lab 6: Batch Growth and Chemostat

The model for the growth of an organism has been developed as below

$$r_g = \mu X = \mu_{max} \left(1 - \frac{P}{P^*}\right)^{0.52} \frac{XS}{Ks + S}$$

$$r_d = k_d X$$

$$r_m = mX$$

If the growth of the organism in a batch reactor can be represented using the following equations

$$V\frac{dX}{dt} = (r_g - r_d)\ V$$

$$V\frac{dS}{dt} = Y_{SX}\ (-r_g)V - (r_m)\ V$$

$$V\frac{dP}{dt} = Y_{PX}\ (r_g V)$$

with the parameters given below

$Y_{XS} = 0.08$ g/g

$Y_{PS} = 0.45$ g/g

$\mu_{max} = 0.33\ h^{-1}$

$K_s = 1.7$ g/l

$k_d = 0.01\ h^{-1}$

$P^* = 90$ g/l

m = 0.03 g substrate / (g cells.h)

V = 10 l

If $X_0 = 1$ g/l; $S_0 = 250$ g/l, obtain

a. A plot of substrate, cell concentration, and product concentration with time till substrate concentration reduces to 10 g/l when grown in batch reactor mode.
b. Obtain plots of $\mu$, $r_d$ and $r_m$ for the course of the batch fermentation.
c. After the substrate concentration of 10 g/l is reached, the reactor is run as a chemostat with the following feed parameters ($X_0 = 0$ g/l; $S_0 = 100$ g/l; $D = 0.5\ h^{-1}$). Obtain a plot for cell, product and substrate concentration in the exit stream of the chemostat as a function of time to their steady state concentrations.