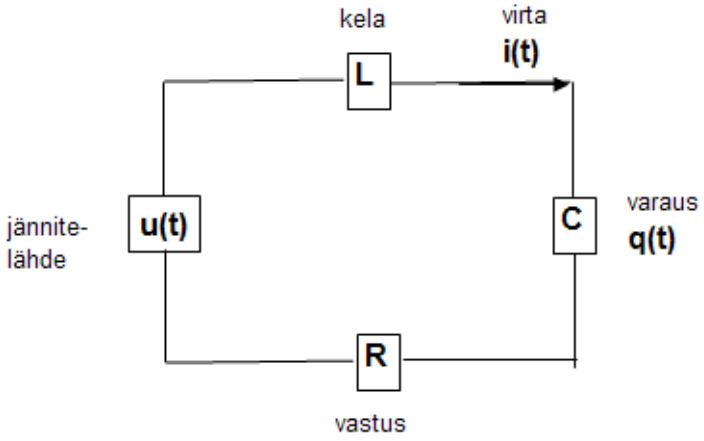
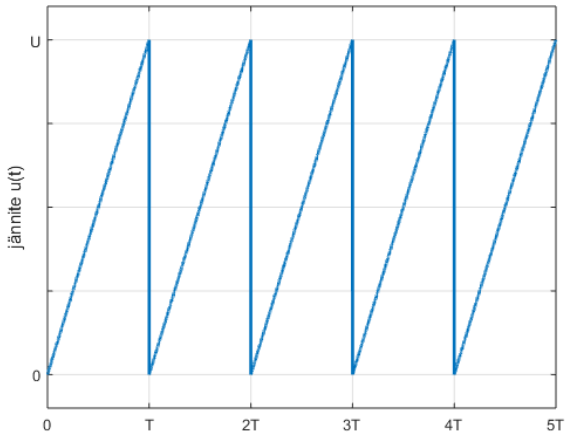
1. Use SIMULINK to draw the graphs of the RLC-circuit voltages



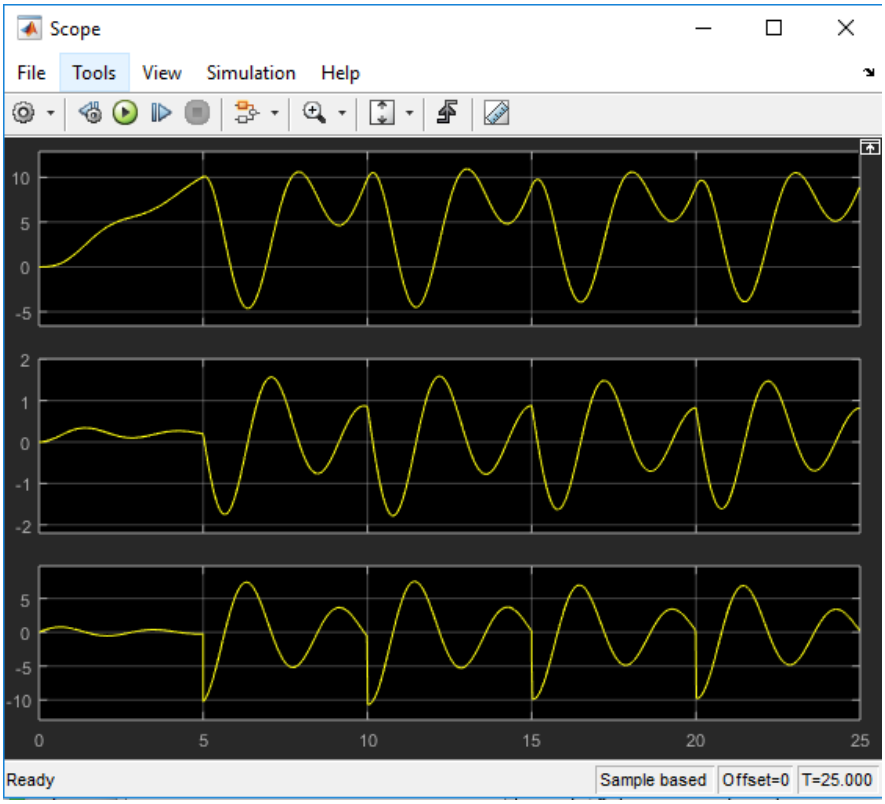
$$U_C = q(t)/C,\ U_R = R\,i(t) \ \text{ and } \ U_L = L\,i'(t)$$

between $t = 0 \ldots 25$, when input voltage $u(t)$ is like below,
$L = 2, R = 1, C = 0.1, U = 10, T = 5$



and the differential equation is

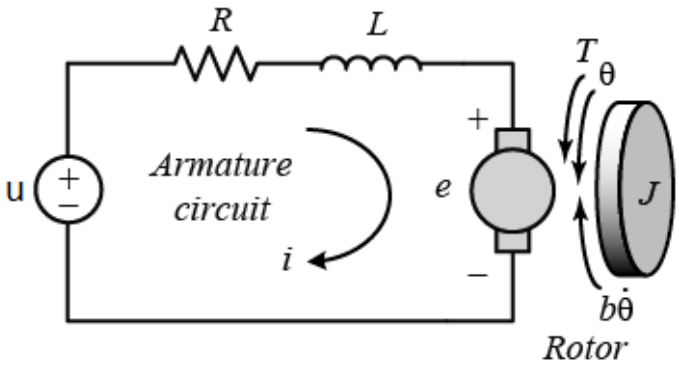
$$L \cdot q''(t) + R \cdot q'(t) + \frac{1}{C} \cdot q(t) = u(t), \quad q(0) = 0,\ q'(0) = 0$$

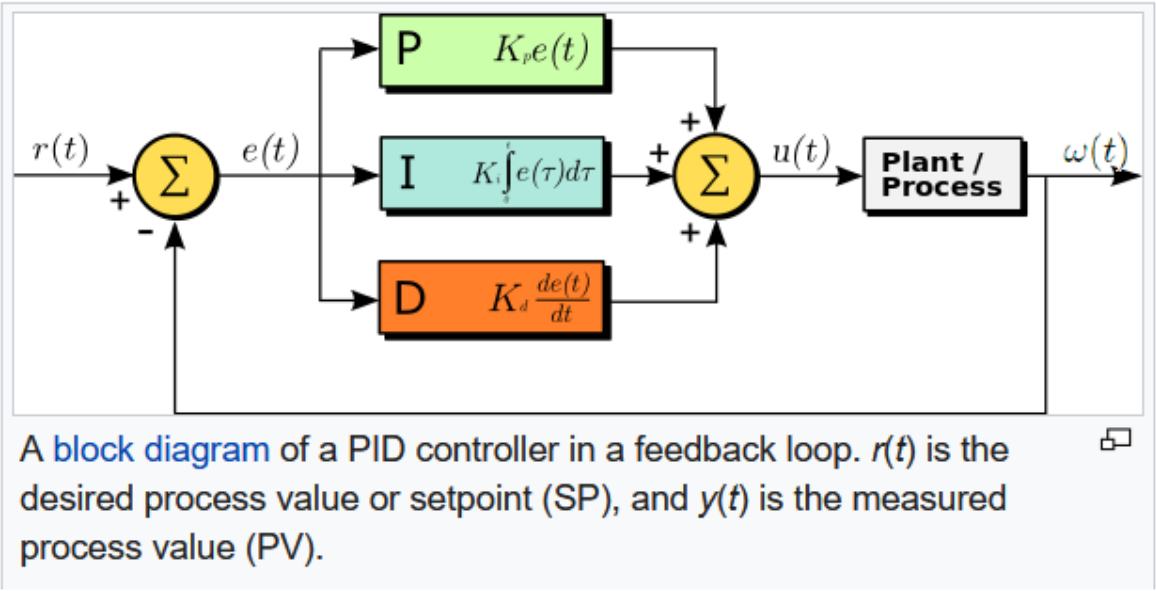


hint: multiplication by numbers: math operations/Gain, derivative Continuous/Derivative

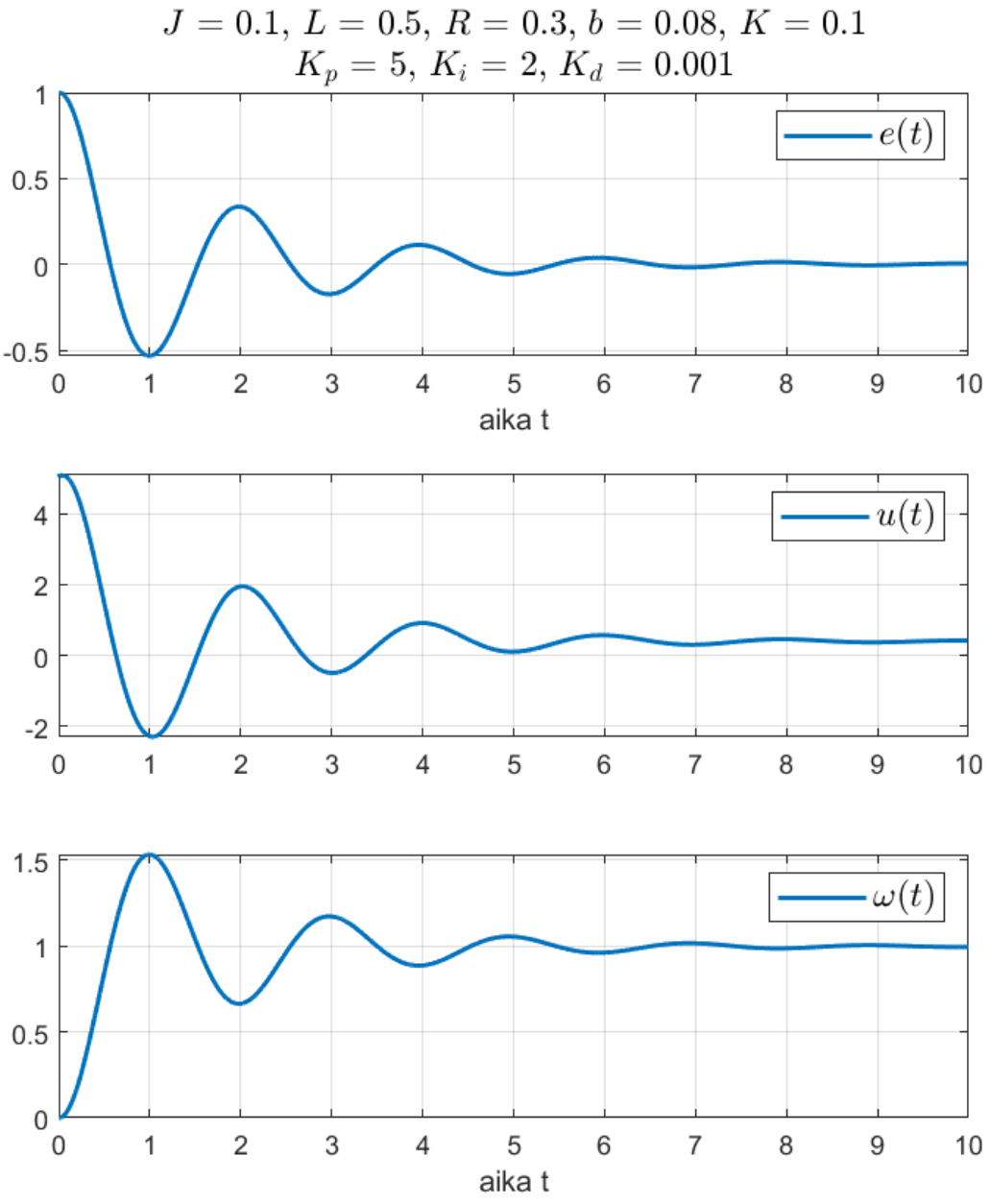
2. (DC-motor) Create SIMULINK-model of the control circuit below and draw graphs of $e(t), u(t)$ and $\omega(t)$, when $r(t) = 1$ and the differential equation is

$$JL\,\omega''(t) + (RJ + bL)\,\omega'(t) + (bR + K^2)\,\omega(t) = K\,u(t)$$

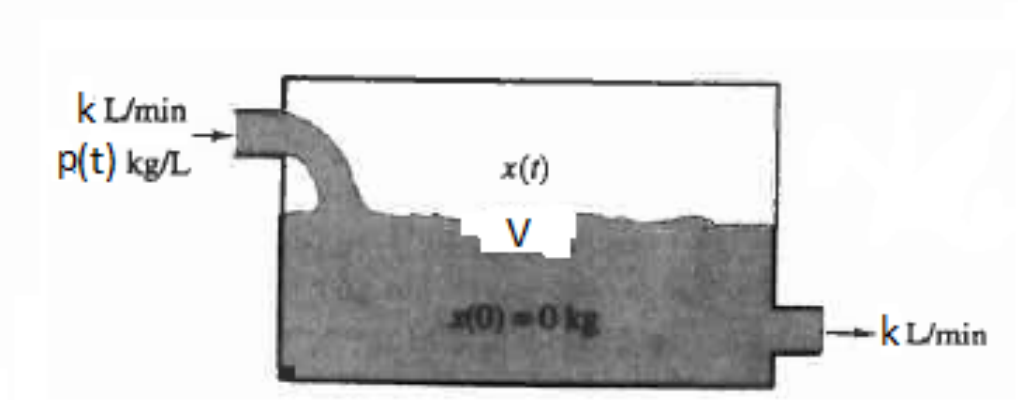




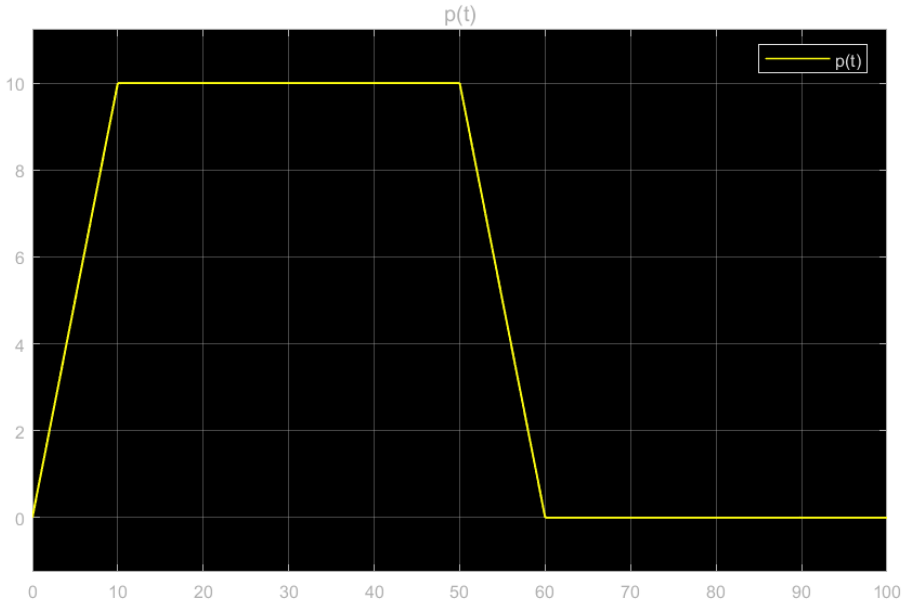
A block diagram of a PID controller in a feedback loop. $r(t)$ is the desired process value or setpoint (SP), and $y(t)$ is the measured process value (PV).

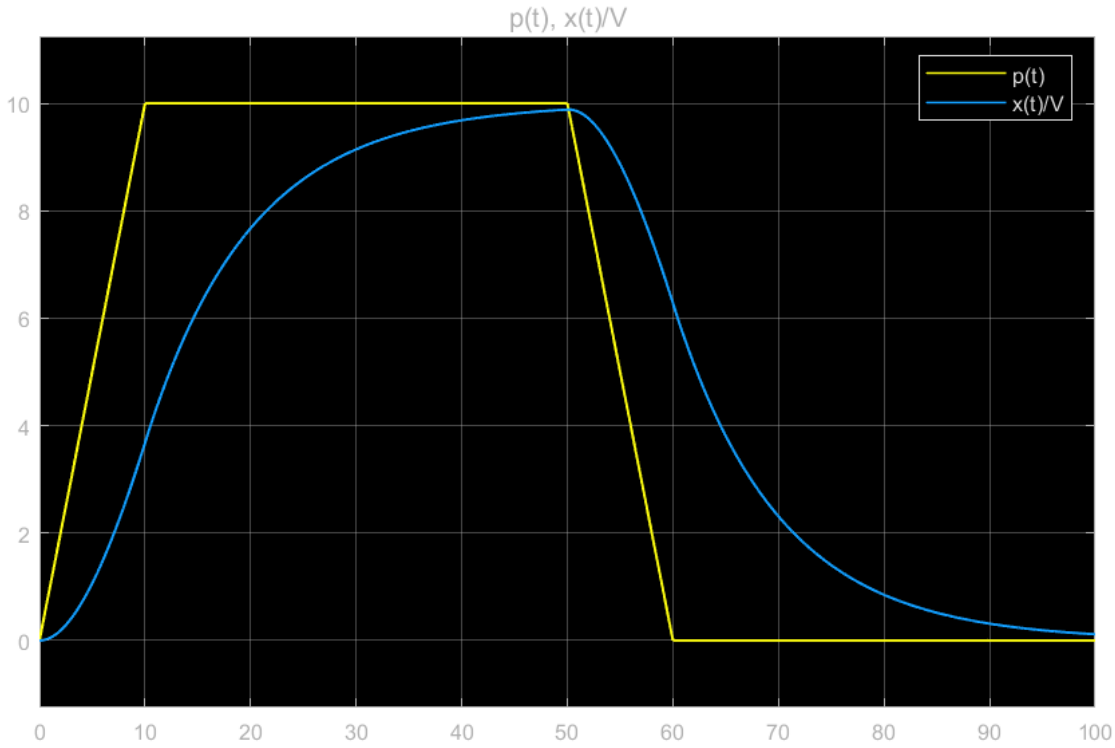

$J = 0.1,\ L = 0.5,\ R = 0.3,\ b = 0.08,\ K = 0.1$
$K_p = 5,\ K_i = 2,\ K_d = 0.001$
$e(t)$
$u(t)$
$\omega(t)$
aika t
aika t

3. Use SIMULINK to draw the graphs of $x(t)/V$ and $p(t)$ (kg/liter) between $t = 0 \ldots 100$, when $V = 100, k = 10$



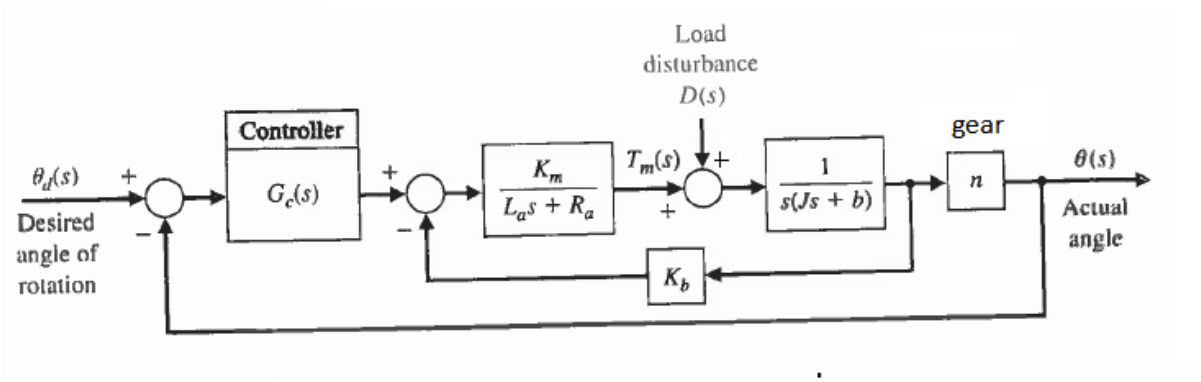
and the graph of $p(t)$ is like below.





hint: $p(t)$ from repeating sequence-block

4. Controller below is PID.



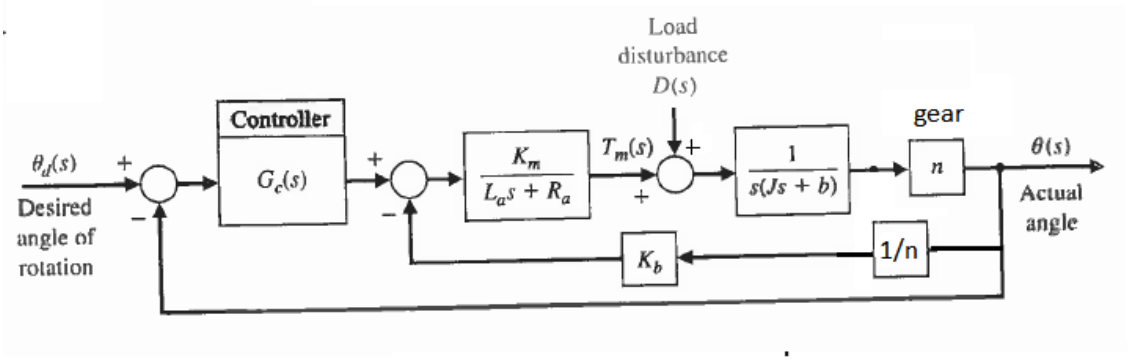
Simplify to one transfer function when

a) input is $\theta_d(s)$ and output $\theta(s)$ (and disturbance $D(s) = 0$)

b) input is $D(s)$ and output $\theta(s)$ (and $\theta_d(s) = 0$)

Check by creating the circuit in SIMULINK and drawing the graph of the output $\theta(t)$, when input $\theta_d(t)/d(t) = 1$.

hint for b):



$K_m = 0.1, L_a = 1, R_a = 20, J = 0.1, b = 1, n = 10, K_b = 1$
$P = 50, I = 10, D = 5$