Exercise

Please try to give the discrete incremental PID formulations. Some notations are given:

- $u(t)$ is the output of a controller in the tth measurement interval.
- $e(t)$ is the error between the target value and measurement value in the tth measurement interval. And the error is measured every T time interval (T is small enough).
- The PID parameters, K_p, K_i and K_d, are all set.

(Hint: incremental means $\Delta u(t) = u(t) - u(t-1)$.)

$$u(t) = K_p * e(t) + K_i * \sum e(t) * T + K_d * \frac{e(t) - e(t-1)}{T} \tag{1}$$

$$u(t-1) = K_p * e(t-1) + K_i * \sum e(t-1) * T + K_d * \frac{e(t-1) - e(t-2)}{T} \tag{2}$$

$$\Delta u(t) = K_p * (e(t) - e(t-1)) + K_i * e(t) * T + K_d * \frac{e(t) - 2e(t-1) + e(t-2)}{T} \tag{3}$$