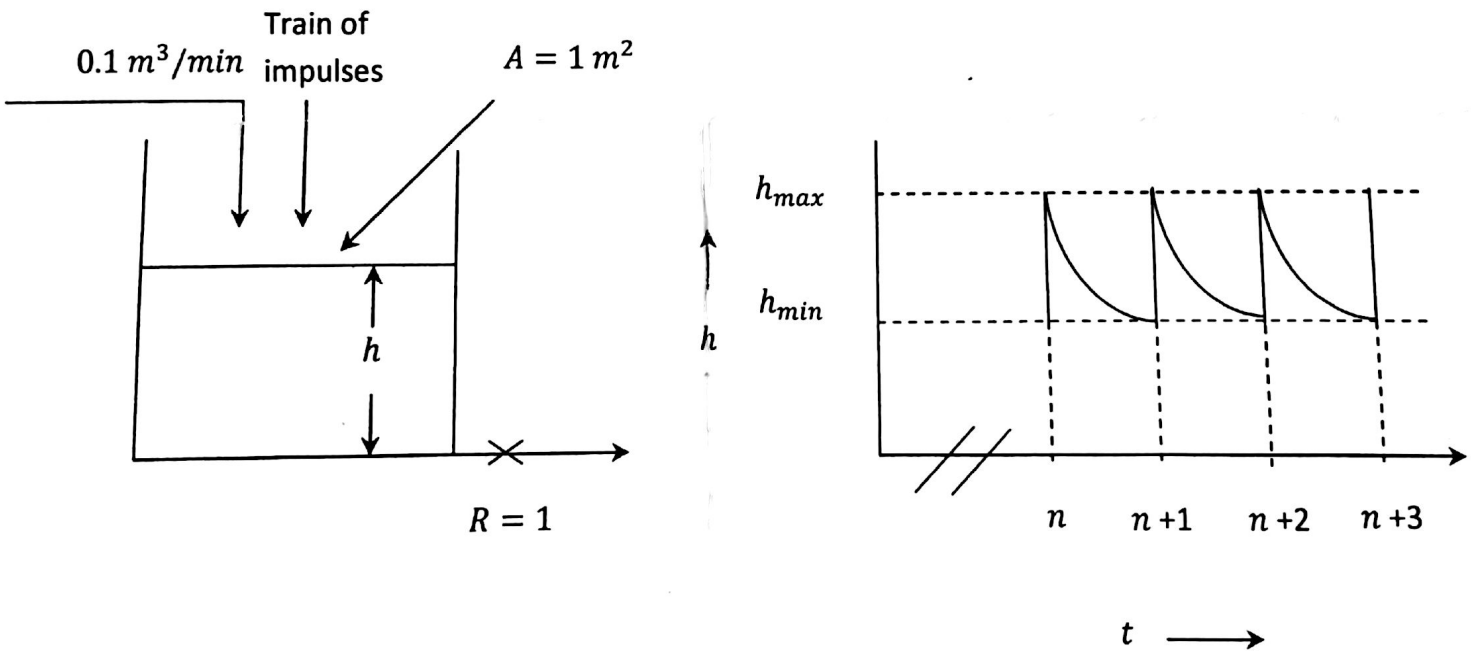
Department of Chemical Engineering, Indian Institute of Technology, Delhi

Subject: CLL261 (Process Dynamics & Control)

Minor 1 (20 Marks), Duration: 1 hr (Open Book: Chemical Process Control by George Stephanopoulos), all questions are compulsory

1) For a second order under-damped system, the reasonable estimate of the response time can be obtained by assuming the condition that the response time perfectly coincides with either the peak or valley of the output response. Under the above condition, derive the expression for the response time for an under-damped system with a unit step input (**Note:** you can directly start with output expression of an under-damped system for a unit step input). **(3+2+2 = 7 Marks)**
2) Find the transfer function parameters (k_p, τ, ζ) of a second order transducer system if the roots of the characteristic equation [i.e. polynomial P(s) as per the terminology used in the class] on complex s-plane are $s_1 = -3 + 2i$ and $s_2 = -3 - 2i$ and the final output change is 5 mA for the input change of 50 mm Hg. **(3+2+2 = 7 Marks)**
3) The liquid-level system shown in figure is initially at steady state with the inlet flow rate 0.1 m^3/min. At time zero, 1 m^3 of water is suddenly added to the tank; at t = 1 min, 1 m^3 is added, etc. In other words, a train of unit impulses is applied to the tank at intervals of one minute. Ultimately the output wave train becomes periodic (after n successive impulses) as shown in the sketch. Determine the maximum (h_{max}) and minimum (h_{min}) values of this output. **(2+2+2 = 6 Marks)**



BEST OF LUCK