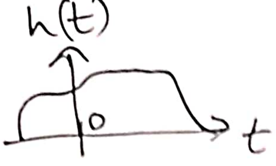
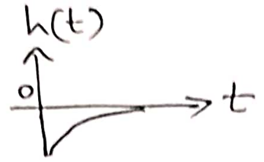
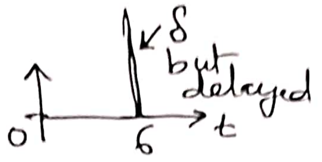
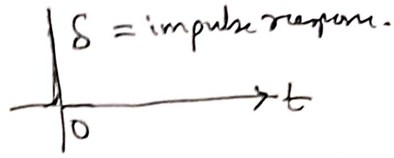
Tutorial Sheet 7th Nov 2023, Control Systems Module. EE103

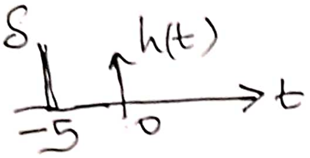
Q1 Consider plot of following impulse responses. For each one, classify into causal/non-causal. Also comment if system is pure delay or pure advance or does nothing.




Give reasons.

Q-2 What would $\delta * u$ be? (for $\delta$ at $t=0$, $t=6$ & $t=-5$).

Q-3: Plot impulse response of systems with transfer functions: within the same figure $\frac{1}{s+1}$, $\frac{-3}{s+1}$, $\frac{1}{s-2}$, $\frac{1}{s+2}$, $\frac{2}{s}$

Q-4: For each tr. fn. above find the diff equation.

Q5 For the diff eqn $\frac{d^3}{dt^3}y - 6\frac{d^2y}{dt^2} - 3\frac{d}{dt}y - 6 = \dot{u} + 3u$

Find relative degree & poles & zeros.

Q-6: for $f_1$ & $f_2$, both 0 for $t<0$ & equal to $e^{-3t}$, $e^{4t}$, find $f_1 * f_2$ by defn of convolution & also using Laplace transform.

Q-7: Find impulse response at output of $G_3$ for connection as

$\delta \rightarrow \boxed{G_1} \rightarrow \boxed{G_2} \rightarrow \boxed{G_3} \rightarrow$ $\quad G_1 = \frac{1}{s-2}$, $G_2 = \frac{3}{s+3}$, $G_3 = \frac{1}{s}$

If $G_1, G_2, G_3$ sequence is interchanged, would impulse response at the final step change? Why?

Q-8 a) For inverted & regular pendulum, find a feedback law $u = -ky$ to get poles (closed loop) at $-2 \pm 3j$

b) Use PD controller & try obtaining. (Assume yourself transfer fn of the pendulums, without friction).

Q-9: Find range of k for closed loop stability for $G(s) =$

$$\frac{1}{s^3+6s^2+11s+6}, \quad \frac{s-10}{s^2+3s+2}, \quad \frac{s+10}{s^2+3s+2}$$ (Assume $k>0$)