

Week 1 - activity 02

$$\frac{d^n y}{dt^n} + a_{n-1} \frac{d^{n-1} y(t)}{dt^{n-1}} + a_{n-2} \frac{d^{n-2} y(t)}{dt^{n-2}} + \dots + a_2 \frac{d^2 y(t)}{dt^2} + a_1 \frac{dy(t)}{dt} + a_0 y(t) = b_m \frac{d^m u(t)}{dt^m} + b_{m-1} \frac{d^{m-1} u(t)}{dt^{m-1}} + \dots + b_1 \frac{du(t)}{dt} + b_0 u(t)$$

using Laplace transform.

$$Y(s) [s^n + s^{n-1} a_{n-1} + s^{n-2} a_{n-2} + \dots + s^2 a_2 + s a_1 + a_0] = U(s) [s^m b_m + s^{m-1} b_{m-1} + \dots + s^2 b_2 + s b_1 + b_0]$$

$$\frac{Y(s)}{U(s)} = \frac{s^m b_m + s^{m-1} b_{m-1} + \dots + s b_1 + b_0}{s^n + s^{n-1} a_{n-1} + \dots + s a_1 + a_0}$$

∴ characteristic equation of the above system is

$$s^n + a_{n-1} s^{n-1} + a_{n-2} s^{n-2} + \dots + a_2 s^2 + a_1 s + a_0 = 0$$

for

$$\frac{d^2 y(t)}{dt^2} + \frac{dy(t)}{dt} + y(t) = u(t)$$

order $n=2$, $a_i = m_i = 1$

Therefore characteristic equation :-

$$\underline{\underline{s^2 + s + 1 = 0}}$$