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(a) Define a dynamic equation

Dynamic equation: is a difference equation in discrete time and also in continuous time, it also relates to the time scale calculus in combined discrete and continuous time.

(b) An engineering system is described by the operation given in equation (1). Develop a dynamic model in form of an ordinary differential equation for the system.

$$y = Ae^{t}$$

Solution

$$y = Ae^{t} \dots (1)$$

$$\frac{dy}{dt} = A \frac{d}{dt} (e^t) + e^t \frac{d}{dt} (At)$$

$$\frac{dy}{dt} = Ae^t + Ae^t \dots (2)$$

From equation (1), name  $Ae^t$  the subject of formula

$$y = Ae^t$$

$$\frac{y}{t} = Ae^t \dots (3)$$

Put equation (1) and (3) in equation (2)

$$= \frac{dy}{dt} = y + \frac{y}{t}$$

Multiply through by  $t$

$$t \frac{dy}{dt} = ty + y$$

$$t \frac{dy}{dt} = ct + y$$

$$\therefore t \frac{dy}{dt} - (ct + y) = 0$$