GATE 2023

EE22BTECH11060 - TEJAVATH KUSHAL*

Q 20 : The solution $x(t)$, $t \geq 0$, to the differential equation $\ddot{x} = -k\dot{x}, k > 0$ with initial conditions $x(0) = 1$ and $\dot{x}(0) = 0$ is:
Ans:

Differential equation	$\ddot{x} = -k\dot{x}$
Initial conditions	$x() = 1$ and $\dot{x}(0) = 0$
$x(t)$	?

TABLE 0
PARAMETER TABLE

$$\implies \frac{d^2x(t)}{dt^2} = -k\frac{dx(t)}{dt} \qquad (1)$$

Taking Laplace transform on both sides,

$$s^2 X(s) - sX(0) - X'(0) = -k(sX(s) - X(0)) \quad (2)$$

$$\left(s^2 + k\right)X(s) - sX(0) = -kX'(0) + X(0) \qquad (3)$$

$$(s + k)X(s) + sX'(s) = X'(0) + X(0) \qquad (4)$$

Taking inverse Laplace transform,

$$\implies x(t) = 1 \qquad (5)$$