GATE 2023 IN 37Q

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Question: The Laplace transform of the continuous-time signal $x(t) = e^{-3t}u(t-5)$ is _____, where $u(t)$ denotes the continuous-time unit step signal.

Solution:

Parameter	Description	Value
$x(t)$	Given Function	$x(t) = e^{-3t}u(t)$
$X(s)$	Laplace Transform of $x(t)$	$\frac{e^{-5(s+3)}}{s+3}$

TABLE 1: Table of parameters

$$e^{-3t}u(t) \xleftrightarrow{\mathcal{L}} \frac{1}{s+3} \quad \Re(s) > -3 \tag{1}$$

Using time shifting,

$$e^{-3(t-5)}u(t-5) \xleftrightarrow{\mathcal{L}} \frac{e^{-5s}}{s+3} \tag{2}$$

$$e^{-15}e^{-3(t-5)}u(t-5) \xleftrightarrow{\mathcal{L}} e^{-15}\frac{e^{-5s}}{s+3} \tag{3}$$

$$e^{-3t}u(t-5) \xleftrightarrow{\mathcal{L}} \frac{e^{-5(s+3)}}{s+3} \tag{4}$$

$$\therefore x(t) \xleftrightarrow{\mathcal{L}} \frac{e^{-5(s+3)}}{s+3} \quad \Re(s) > -3 \tag{5}$$

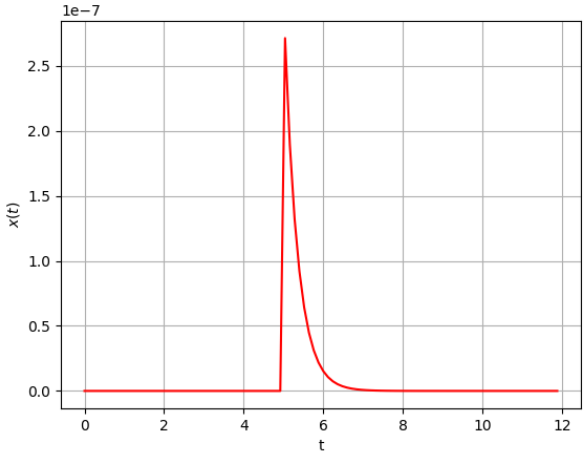

Fig. 3: Plot of $x(t)$ vs t. See Table 1