GATE: CH - 34.2022

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Question: A process described by the transfer function

$$G_p(s) = \frac{(10s+1)}{(5s+1)}$$

is forced by a unit step input at time $t = 0$. The output value immediately after the unit step input (at $t = 0^+$) is ? (Gate 2022 CH 34)

Solution:

Parameters	Description
$G_p(s) = \frac{Y(s)}{X(s)}$	Transfer function
$Y(s)$	Laplace transform of $y(t)$
$X(s)$	Laplace transform of $x(t)$
$x(t) = u(t)$	unit step function

TABLE I: Given parameters

$$G_p(s) = \frac{Y(s)}{X(s)} = \frac{(10s+1)}{(5s+1)} \tag{1}$$

$$u(t) \xleftrightarrow{\mathcal{L}} \frac{1}{s} \tag{2}$$

From equation (2):

$$Y(s) = \frac{(10s+1)}{s(5s+1)} \tag{3}$$

By Initial value theorem:

$$\lim_{t\to 0^+} y(t) = \lim_{s\to\infty} sY(s) \tag{4}$$

$$= \lim_{s\to\infty} \frac{(10s+1)}{(5s+1)} \tag{5}$$

$$= 2 \tag{6}$$

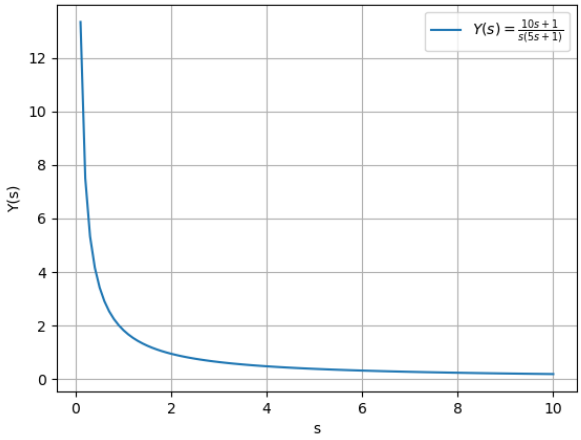

Fig. 1: Graph of y(t)