GATE ASSIGNMENT 3

Ananthoju Pranav Sai
AI20BTECH11004

Download all python codes from

```
https://github.com/Ananthoju-Pranav-Sai/EE3900/blob/main/Gate_Assignment_3/codes
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and latex-tikz codes from

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https://github.com/Ananthoju-Pranav-Sai/EE3900/tree/main/Gate_Assignment_3/Gate_Assignment_3.tex
```

1 GATE EC 2004 Q.64

A casual system having the transfer function $H(s) = \frac{1}{s+2}$ is exicted with $10u(t)$. The time at which the output reaches 99% its steady state value is ?

2 Solution

Given the transfer function,

$$H(s) = \frac{1}{s+2} \tag{2.0.1}$$

$$\implies \frac{Y(s)}{X(s)} = \frac{1}{s+2} \tag{2.0.2}$$

and input signal,

$$x(t) = 10u(t) \tag{2.0.3}$$

By applying Laplace transform

$$\mathcal{L}\{x\}(s) = 10\mathcal{L}\{u\}(s) \tag{2.0.4}$$

We know that Laplace transform of unit step function ($u(t)$) is $\frac{1}{s}$ (discussed in class)

$$X(s) = \frac{10}{s} \tag{2.0.5}$$

$$\implies Y(s) = \frac{10}{s(s+2)} \tag{2.0.6}$$

$$\implies Y(s) = 5\left(\frac{1}{s} - \frac{1}{s+2}\right) \tag{2.0.7}$$

Applying inverse Laplace transform on $Y(s)$ for output signal $y(t)$

$$y(t) = \mathcal{L}^{-1}\{Y(s)\}(t) \tag{2.0.8}$$

$$\implies y(t) = 5(1 - e^{-2t}) \tag{2.0.9}$$

So the steady state value of output signal is 5. Time taken to reach 99% of its steady state value will be

$$5(1 - e^{-2t}) = (0.99)5 \tag{2.0.10}$$

$$\implies e^{-2t} = 0.01 \tag{2.0.11}$$

$$\implies t = 2.3sec \tag{2.0.12}$$

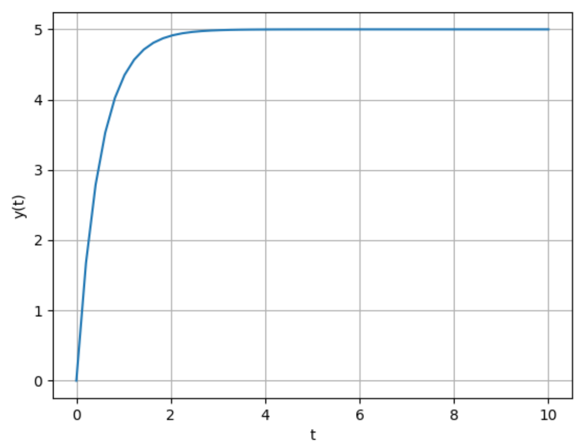

Fig. 0: Plot of output signal y(t)