
SIGNAL PROCESSING

Through GATE

EE1205-TA Group

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Introduction

This book provides solutions to signal processing problems in GATE.

Chapter 1

Harmonics

1.1

Chapter 2

2.1

Chapter 3

Z-transform

Chapter 4

Systems

4.1

Chapter 5

5.1

Chapter 6

Sampling

6.1

Chapter 7

Contour Integration

7.1

Chapter 8

Laplace Transform

8.1 Consider the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0$. The boundary conditions are $y = 0$ and $\frac{dy}{dx} = 1$ at $x = 0$. Then the value of y at $x = \frac{1}{2}$ (GATE AE 2022)

Solution:

Parameters	Values	Description
$y(0)$	0	y at $x = 0$
$y'(0)$	1	$\frac{dy}{dx}$ at $x = 0$

Table 8.1: Parameters

$$\frac{d^2y}{dx^2} \xleftrightarrow{\mathcal{L}} s^2Y(s) - sy(0) - y'(0) \quad (8.1)$$

$$\frac{dy}{dx} \xleftrightarrow{\mathcal{L}} sY(s) - y(0) \quad (8.2)$$

Applying Laplace Transform, using (8.1) and (8.2),

$$s^2Y(s) - sy(0) - y'(0) - 2(sY(s) - y(0)) + Y(s) = 0 \quad (8.3)$$

From Table 8.1,

$$(s^2 - 2s + 1)Y(s) - 1 = 0 \quad (8.4)$$

$$Y(s) = \frac{1}{(s-1)^2} \quad (8.5)$$

$$t^n \xleftrightarrow{\mathcal{L}} \frac{n!}{s^{n+1}} \quad (8.6)$$

$$e^{at}x(t) \xleftrightarrow{\mathcal{L}} X(s-a) \quad (8.7)$$

Taking Inverse Laplace Transform for $Y(s)$, using (8.6) and (8.7),

$$y(x) = xe^x \quad (8.8)$$

$$\implies y\left(\frac{1}{2}\right) = \frac{\sqrt{e}}{2} \quad (8.9)$$

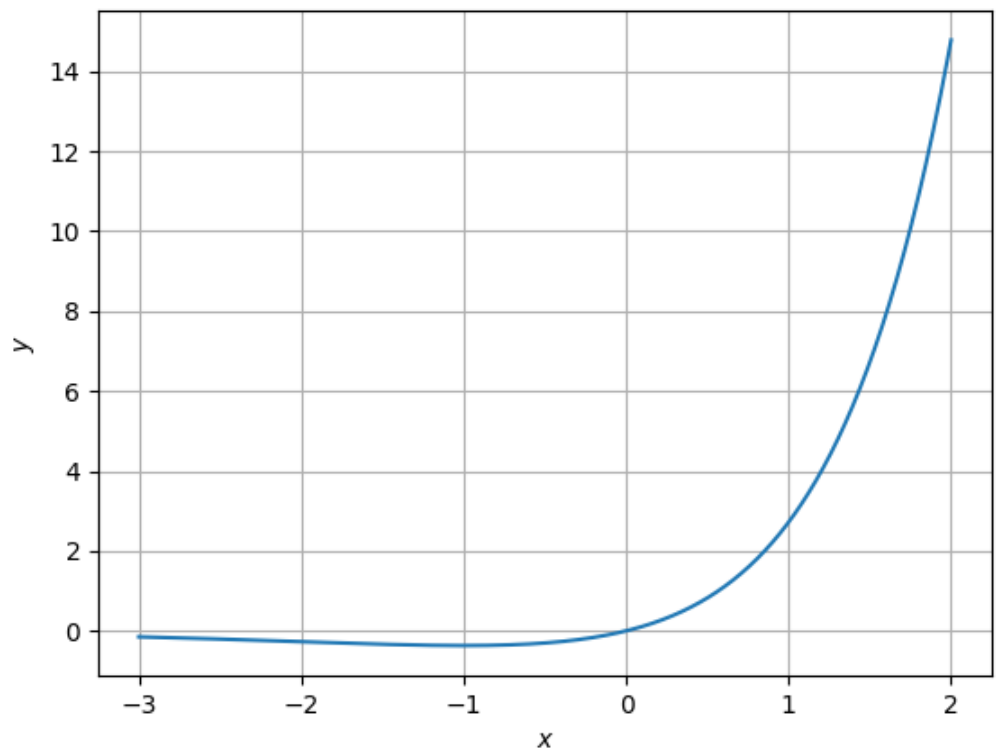


Figure 8.1: Plot of $y(x)$

Chapter 9

Fourier transform

9.1

