

CALCULUS 3

Solutions for Final Exam

Question 1. Apply z -transform to both sides of the DE

$$y_{k+2} - 5y_{k+1} + 4y_k = \frac{1}{5^k}$$

use the advancing property to get

$$(z^2 Y(z) - z^2 y_0 - z y_1) - 5(z Y(z) - z y_0) + 4Y(z) = \frac{z}{z - 1/5} = \frac{5z}{5z - 1}$$

Use initial conditions $y_0 = -1, y_1 = 0$, we obtain

$$(z^2 Y(z) + z^2) - 5(z Y(z) + z) + 4Y(z) = \frac{5z}{5z - 1}$$

Re-arrange terms to get

$$(z^2 - 5z + 4)Y(z) = \frac{5z}{5z - 1} - z^2 + 5z = \frac{-5z^2 + 26z^2}{5z - 1}$$

This yields

$$\begin{aligned} \frac{Y(z)}{z} &= \frac{-5z^2 + 26z}{(5z - 1)(z^2 - 5z + 4)} = \frac{-5z^2 + 26z}{(5z - 1)(z - 4)(z - 1)} \\ &= \frac{(8/19)}{z - 4} - \frac{(7/4)}{z - 1} + \frac{(25/76)}{z - 1/5}. \end{aligned}$$

Thus

$$Y(z) = \frac{(8/19)z}{z - 4} - \frac{(7/4)z}{z - 1} + \frac{(25/76)z}{z - 1/5}.$$

Taking inverse z -transform gives us

$$\{y_k\} = \left\{ \frac{8}{19} 4^k - \frac{7}{4} + \frac{25}{76} \frac{1}{5^k} \right\}, \quad k \geq 0.$$

Question 2. The function

$$f(t) = 2t \quad (-1 < t < 1), \quad f(t) = f(t + 2)$$

is a periodic odd function with $T = 2$, so $a_n = 0$ for all n . $\omega = 2\pi/T = \pi$.

$$\begin{aligned} b_n &= \frac{4}{2} \int_0^1 f(t) \sin n\omega t dt = 2 \int_0^1 2t \sin(n\pi t) dt \\ &= 4 \int_0^1 \frac{-1}{n\pi} t d \cos n\pi t \\ &= \frac{-4}{n\pi} t \cos n\pi t \Big|_0^1 + \int_0^1 \frac{4}{n\pi} \cos n\pi t dt \\ &= \frac{4}{n\pi} (0 - (-1)^n) + \frac{4}{(n\pi)^2} \sin n\pi t \Big|_0^1 \\ &= \frac{4}{n\pi} (-1)^{n+1}, \quad n \geq 1. \end{aligned}$$

Calculus 3 Problems And Solutions

DJ Losen



Calculus 3 Problems And Solutions:

Precalculus Mehdi Rahmani-Andebili, 2024-01-05 The second edition of this study guide is written and designed for students taking a precalculus course It includes new and expanded exercises with final answers that will help students to review and sharpen their knowledge of the subject and enhance their performance in the classroom The author uses methods typically found in instructor recommended textbooks offering detailed solutions multiple methods for solving problems and clear explanations of concepts This hands on guide will improve students problem solving skills and foster a solid understanding of calculus which will benefit them in all of their calculus based courses

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