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SHOW ALL WORK!

Problem 1 (25 pts)

For the function $f(x) = \sin \pi x$

a) Find the second order truncated Taylor Series expansion of $f(x)$ about some point x_0. The expression for $f_2(x)$ should be in terms of x, x_0 and the appropriate derivatives of the function $\sin\pi x$ evaluated at x_0.

b) Simplify the expression for $f_2(x)$ when $x_0 = 0.5$

c) Find the true error E_T when using $f_2(x)$ to approximate $f(x)$ at $x = 0.6$

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Problem 2 (25 pts)

Consider the function $f(x) = \cos x$.

a) Find the fourth order truncated series expansion of $f(x)$ about the point $x_0 = 0$.

b) Use the fourth order truncated series $f_4(x)$ to estimate the root of $f(x) = 0$ located between 0 and 2. In other words, use the Bisection Method to locate the root of

$$f_4(x) = 0$$

Fill in the table below and stop when the magnitude of the approximate relative error is less than 5 % or after 5 iterations, whichever comes first. Express x_l, x_u, and x_r to 4 places after the decimal point and the remaining columns to 2 places after the decimal point

x_l	x_u	x_r	$f(x_l)$	$f(x_r)$	$\lvert e_A \rvert$, %
0.0000	2.0000				

c) Find the true root R of $f_4(x) = 0$ by letting $y = x^2$ and solving the resulting quadratic in y for its two roots and then using $x = \sqrt{y}$.

d) Find the true error $E_T = R - x_r$.

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Problem 3 (25 pts)

Solve the system of equations A**x** = **b** below by the Gauss-Jordan Method, i.e. start with the augmented matrix (A | **b**) and transform it to (I | **b**') by a sequence of elementary row operations so that the solution is **x** = **b**'.

$$\begin{aligned}
2u - x + 4y - 3z &= 0 \\
-4u + x + 2y + z &= 8 \\
3u + x + y - 2z &= 0 \\
u + x + y + z &= 10
\end{aligned}$$

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Problem 4 (25 pts)

The system of equations A**x** = **b** below is inconsistent, i.e. there is no solution. Find the value(s) of *K*.

$$
\begin{aligned}
x_1 + x_2 + 7x_3 - 4x_4 &= 1 \\
2x_1 - x_2 + 4x_3 - 3x_4 &= 2 \\
-4x_1 + x_2 + 2x_3 + x_4 &= 3 \\
Kx_1 + 2x_2 + 3x_3 - x_4 &= 4
\end{aligned}
$$

Hint: The matrix *A* must be singular.