

Math 229 Calculus Computer Lab Fall 10 Sample Final

- You may use only MATLAB during this exam. No calculators.

Problem 1. (10pts.) Use MATLAB to find all x (to three decimal places) where

$$5 \cos(4x) = x^2 - 12$$

Give the answer, and write the MATLAB commands used to get your answer.

Problem 2. (10pts.) Let $f(x) = \cos(x) - 2x$. Starting at $x_0 = 1$, apply Newton's method to find where $f(x) = 0$ to four decimal places. Write the iterations x_1, x_2, \dots as many as needed.

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

Problem 3. (10pts.) Let $f(x) = 3x^6 - 8x^2 - 24$.

- Write the commands to compute the roots of $f(x)$ using the `roots` function in MATLAB.
- How many real and complex roots are listed as the output of the `roots` function?
- What are the real root(s) to four decimal places?

Problem 4. (10pts.)

Find the minimum of $f(x) = \left(2 \sin(x+1) + \frac{2}{(x-\pi)^4}\right)$ on $(0, \pi)$. Write the x -value to three decimal places, and the final MATLAB commands you used to get your answer.

Problem 5. (20pts.) Let $f(x) = \sqrt{5x} \sin\left(\frac{3}{\sqrt{x}}\right)$ for $x > 0$.

- Write the m-file for the function $f(x)$.
- Compute $f(\sqrt{7})$ to ten decimal places. (Do not use scientific notation.)
- Compute $\lim_{x \rightarrow 0^+} f(x)$ to four decimal places. (Do not use scientific notation.)
- Compute $\lim_{x \rightarrow \infty} f(x)$ to four decimal places. (Do not use scientific notation.)
- Find the x -value of the absolute minimum of $f(x)$ to three decimal places.

Problem 6. (20pts.) Let $f(x) = \tan(x/6) \cos(x-1)$.

- (a) Write the m-file for the function $f(x)$.
- (b) Plot $f(x)$ and its approximate derivative with $h = 0.001$, for $0 \leq x \leq 2\pi$.
Find the x -coordinates of the following points (accurate to three decimal places):
 - (i) Points where $f(x) = 0$:
 - (ii) Points where $f'(x) = 0$:
 - (iii) Points where $f''(x) = 0$ (Recall, $f''(x)$ is the first derivative of $f'(x)$):
 - (iv) Points where $f(x) = f'(x)$:

Problem 7. (20pts.) Find the point $P(x, y)$ on the curve $y = e^{x/2}$ that is closest to the point $Q(5, 3)$.

- (a) What function $d(x, y)$ gives the distance from $P(x, y)$ on the curve to $Q(5, 3)$?
- (b) Write the m-file for the function $d(x)$ (depending only on x) that gives the distance from $P(x, y)$ on the curve to $Q(5, 3)$.
- (c) Using $d(x)$ from part (b), what is `difquo` for $d'(x)$ with $h = 0.001$?
- (d) Plot `difquo` for $0 \leq x \leq 5$. For which x is $d'(x) = 0$ (to three decimal places)?
- (e) What is $P(x, y)$ on the curve? Give coordinates to three decimal places.
- (f) Why is this x -value a minimum for $d(x)$? Apply the first derivative test: How does the graph cross the x -axis?