INSTRUCTIONS: Books, notes, and electronic devices are **not** permitted. Fill out your bluebook properly including lecture number and instructor name. Also make a **grading table** with room for 6 problems and a total score. **Start each problem on a new page.** $\boxed{\text{Box}}$ **your final answers.** A correct answer with incorrect or no supporting work may receive no credit. **SHOW ALL WORK**

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1. (14 points) Consider the function $f(x) = \cos^2 x$ on the interval $[-\pi, \pi]$.
   (a) On which intervals is $f(x)$ increasing and on which intervals is $f(x)$ decreasing?
   (b) Name any points of inflection. Make sure to **verify** the points are indeed points of inflection.

2. (16 points) For two resistors, R_1 and R_2, connected in parallel, the combined electrical resistance R is given by $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$. Further note that R, R_1, and R_2 are all functions of time and are measured in ohms. R_1 and R_2 are each increasing at rates of $\frac{1}{2}$ ohms per second. At what rate is the combined resistance changing when $R_1 = 2$ ohms and $R_2 = 4$ ohms?

3. Consider the function $h(x) = \sqrt{25 - x^2}$.
   (a) (12 points) What is an appropriate linear approximation that could be used to estimate $h(2.9)$?
   (b) (2 points) Would the linear approximation of $h(2.9)$ provide an overestimate or an underestimate?

4. (16 points) Consider the function $f(x) = \sqrt{x^2 - 25}$.
   (a) Determine whether Rolle's theorem can be applied to $f(x)$ on $[-13, 13]$.
   If so, then find all values of c in $(-13, 13)$ satisfying the conclusion of the theorem.
   If not, then explain why the theorem does not apply in this instance.
   (b) Determine whether the Mean Value Theorem can be applied to $f(x)$ on $[5, 13]$.
   If so, then find all c guaranteed by the theorem.
   If not, then explain why the theorem does not apply in this instance.

5. (12 points) Determine the point(s) at which the graph of $y^4 = y^2 - x^2$ has a horizontal tangent. Hint: there is no horizontal tangent at the origin.

6. (28 points) Indicate, in your blue book, the following statements as True or False. No explanation required.
   (a) A point c in $(-2, 2)$ is guaranteed to exist such that the instantaneous rate of change of $f(x) = \dfrac{x}{(x^2+1)^2}$ is $\dfrac{1}{25}$.
   (b) $g(x) = x^{\frac{2}{3}}(2 - x)$ has a local minimum at $x = 0$.
   (c) $x = 0$ is a critical point and local extremum of $f(x) = x^4 - 2x^3$.
   (d) The origin is a point of inflection for the function $f(x) = x^6$.
   (e) The function $g(x) = \begin{cases} x^2, & -1 \le x < 2 \\ 9 - 3x, & 2 \le x \le 3 \end{cases}$ has an absolute maximum of 4.
   (f) Every point where a function possesses a horizontal tangent is a local extremum of the function.
   (g) The point of inflection of $f(x) = x(x - 6)^2$ lies midway between the relative extrema of f.

$\boxed{\text{END of Exam}}$