Sample Exam 2

1. Use the Second Derivative Test to determine the relative extrema of the function $f(x) = x + \frac{4}{x}$.

2. Find the derivatives of the following functions.

$$(i).\quad f(x) = e^{x^2+1}; \quad (ii).\quad g(x) = \ln\left\{\frac{(x-1)^7\sqrt{x+1}}{x^2+1}\right\}.$$

3. Let $f(x) = x^2e^{-x}$ defined in $(-\infty, \infty)$. Find the intervals of increasing and decreasing of f and relative extrema of f.

4. A culture of bacteria that initially contained 2000 bacteria has a count of 18,000 bacteria after 2hr. Determine the function $Q(t)$ that expresses the exponential growth of the number of cells of this bacterium as a function of time t in minutes and use it to find the number of bacteria present after 4hr.

5. Let $f(x) = e^{-x^2}$. Find the intervals of concavity of f and the inflection points.

6. Determine the horizontal and vertical asymptotes of $f(x) = \dfrac{\sqrt{4x^4+1}}{x^2-2x-3}$.

7. The speed of traffic flow on a certain stretch of Route US 70 between 6 am to 10 am on a typical weekday is approximated by the function

$$f(t) = 2t - 4\sqrt{t} + 72 \qquad (0 \le t \le 4)$$

where $f(t)$ is measured in miles per hour and t is measured in hours, with $t = 0$ corresponding to 6 am. Find the largest speed and smallest speed during this time period.

8. An open box is to have a square base and a volume of 10 cubic feet. If the material for the base costs 5 dollars per square feet, and the material for the four sides costs 2 dollars per square feet. Determine the dimensions of the box with minimum cost.