Name. _____ **Section**. _____

Applied Differential Equations 2250-1 and 2250-3
Midterm Exam 1, Fall 2002
Exam Date: Friday, 13 September, 2002

Instructions. The four problems below are take-home, due on the date above. Answer checks are expected. If `maple` assist is used, then please attach the `maple` output.

The remaining 20% of the exam is in class, 15 minutes, one problem, of a type similar to one of the problems below. Calculators, hand-written or computer-generated notes are allowed, including xerox copies of tables or classroom xerox notes. Books are not allowed.

Scores

_____ **Problem 1**. Quadrature Equations.
_____ **Problem 2**. Separable Equations.
_____ **Problem 3**. Linear Equations.
_____ **Problem 4**. Application.
_____ **Problem 5**. In-class, Sept 13.
_____ **Average**.

1. **(Quadrature Equations)** Solve by the method of quadrature the initial value problem $y''' = x + xe^{-x} - \sin 2x$, $y(0) = y'(0) = 0$, $y''(0) = 3$. Show all integration steps (by hand).

2. **(Separable Equations)** Solve the separable problem for the *implicit* and *explicit* solutions. Distinguish equilibrium and non-equilibrium solutions as needed.

$$2y' = \sin x - \tan x - 4y^2(1 - \sec x)\sin x.$$

3. **(Linear Equations)** Solve the linear equation $2xy'(x) + 3y(x) = \sqrt{x}e^{-2x}$, $y(1) = 5$. Expected details include the factorization method and all integration steps (by hand).

4. **(Application: Torricelli's law)** A water tank has the shape of $y = x^{4/3}$ revolved around the y-axis. The depth of the water is 10 feet. After 1 hour and 45 minutes, the drain hole at $(0, 0)$ empties the tank to a depth of 6 feet. Find the additional time it takes to empty the tank. Ref: Exercise 1.4-52 and equation 1.4-(24).