

**NDU**

**MAT 235**

**Ordinary Differential Equations**

**Final Exam**

**Duration: 2 hours**

**Name:** \_\_\_\_\_

**Section: A**

**Instructor: Dr. Ishac Zoghbi**

**Grade:** \_\_\_\_\_

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**MAT 235 – Final Exam; Wednesday August 11, 2004**

**Name:**

**Instructor: Dr. Ishac Zoghbi**

**Please note that you have 10 questions 13 pages and your mobile must be turned off and unseen**

1) (8 points) Solve the differential equation  $(2xy - e^x)dx + (-2x - 2)dy = 0$ .

**2) (8 points)** Solve the initial-value problem

$$\frac{dy}{dx} = (x^2 + y)^2 + 2(x^2 + y) + 1 - 2x; \quad y(0) = -2.$$

Hint: Let  $v = x^2 + y$

**3) (8 points)** Solve  $y'' + 4y' + 4y = \frac{e^{-2x}}{x^4}$ ; for  $x > 0$ .

**4) (6 points)**

a) Find the general solution of the following differential equation.

$$y = xy' + y' - y' \ln|y'|$$

b) Find a singular solution.

**5) (10 points)** Use Laplace transform to solve

$$y'' - 3y' + 2y = h(t), \text{ where } h(t) = \begin{cases} 2; & 0 \leq t < 4 \\ 0; & t \geq 4 \end{cases}$$

$$\text{with } y(0) = y'(0) = 0.$$

**6) (8 points)** Find the Laplace inverse of  $F(s) = \ln \left| \frac{s-3}{s-2} \right|$ .

**7) (12 points)** Use Laplace transform to solve

$$\begin{cases} y_1' - 4y_1 - y_2 = 0 \\ y_2' - 2y_1 - 3y_2 = 0 \end{cases}; y_1(0) = 4, y_2(0) = -5.$$



**8) (10 points)** Use the eigenvalue-eigenvector method to solve  $\begin{cases} y_1' = 2y_1 + 4y_2 \\ y_2' = 3y_1 - 2y_2 \end{cases}$ .

**9) (12 points)** Given that  $x_0 = 0$  is an ordinary point of the differential equation  $(x^2 - 1)y'' - 2xy' + 2y = 0$ . Find the general power series solution in powers of  $x$ .



**10) (18 points)** Given  $(x - x^2)y'' + (2 - 4x)y' - 2y = 0$ ; for  $0 < x < 1$ .

a) Show that  $x_0 = 0$  is a regular singular point.

b) Find the indicial roots.

c) Find the generalized power series solution in powers of  $x$ .

