King Fahd University of Petroleum & Minerals

Math 202 - 4 & 5

Dr. Jawad Y. Abuihlail

Third Major Exam **Semester 042** **90 Minutes**

Name: **ID #:**

Section #: 4 9:00 - 10:00 *or* **5 10:00 - 11:00**

Q1. (10 Points - Suggested time: 5 minutes) State if each of the following statements is true or false:

1. An eigenvalue λ_0 of a 3×3 matrix may have 3 linearly independent eigenvectors.
2. The point $x_0 = 1$ is regular with respect to the 2nd order ODE
$$(x-1)y'' + (x^3-1)y' + (x^2-1)y = 0.$$
3. A square matrix with real entries can have no non-real eigenvectors.
4. $f(x) = \ln(x+1)$ is not analytic at $x_0 = 0$.
5. If $f(x)$ & $g(x)$ are analytic at x_0, then $\frac{f(x)}{g(x)}$ is also analytic at x_0.

Q2. (20 Points - Suggested time: 15 minutes) Find the solution of following IVP:

$$y'' + xy' - 2y = 0;\ y(0) = 0,\ y'(0) = 1.$$

Q3. (20 Points - Suggested time: 20 minutes) Find the general solution of following ODE in powers of x (i.e. $x_0 = 0$):

$$xy'' - (x+1)y' - y = 0$$

Q4. (20 Points - Suggested time: 15 minutes) Find the general solution of following system of ODE's

$$\begin{aligned} \frac{dx}{dt} &= 2x - y \\ \frac{dy}{dt} &= 3x + y \end{aligned}$$

Q5. (30 Points - Suggested time: 25 minutes) Find the general solution of following system of ODE's

$$\begin{aligned} \frac{dx}{dt} &= 2x - y + z \\ \frac{dy}{dt} &= 3x - y - 3z \\ \frac{dz}{dt} &= x - y + z \end{aligned}$$