King Fahd University of Petroleum and Minerals

Second Major Exam for Math 202

Time allowed 1 hour and 30 minutes

Full Name: .....

ID Number: .....

Section: .....

Note The following things are prohibited

- Using an advanced calculator
- Having the mobile phone on
- Talking to each other
- Cheating

Major 2

Problem 1 (6 Points) Let $\phi(x) = C_1 + C_2e^x + C_3e^{2x}$.

i- Verify that $\phi(x)$ form the general solution of the homogeneous DE: $y''' - 3y'' + 2y' = 0$ on $(-\infty, \infty)$.

ii- Find the general solution of the nonhomogeneous DE: $y''' - 3y'' + 2y' = 4x$.

Problem 2 (10 Points) Find the general solution of the DE: $y'' - 2y' + 2y = 5\sin x$.

Problem 3 (4 Points) The function $y_1 = x\sin(\ln x)$ is a solution of $x^2y'' - xy' + 2y = 0$ on $I = (0, \infty)$.

i- Find a second solution y_2 such that y_1, y_2 form a fundamental set of solutions of the given DE on I.

ii-Show that y_1, y_2 are linearly independent.

Hint $\int \frac{dt}{\sin^2 t} = -\cot t + C$.

Problem 4 (10 Points) Find the general solution of the nonhomogeneous Cauchy-Euler DE: $x^2y'' + xy' - y = x\ln x$ on $(0, \infty)$.

Problem 5 (10 Points) Consider the following DE: $(x^2 + 2)y'' + 3xy' - y = 0$.

i- Find the singular points.

ii- Use the power series method to solve the given DE.