King Fahd University of Petroleum and Minerals

Department of Mathematics and Statistics

Math 202
Exam II – 2015–2016 (151)
Thursday, November 5, 2015

Allowed Time: 2 Hours

Name: _____

ID #: _____

Section #: _____ Serial Number: _____

Instructions:

1. Write clearly and legibly. You may lose points for messy work.
2. **Show all your work**. No points for answers without justifications.
3. **Calculators and Mobiles are not allowed.**
4. Make sure that you have **7 different** problems (7 pages + cover page)

Question #	Grade	Maximum Points
1		**05**
2		**18**
3		**13**
4		**17**
5		**23**
6		**12**
7		**12**
Total:		**100**

1. Given that $w = \ln x$ is a solution of the differential equation:

$$x^2\, y'' + xy' + \frac{1}{\ln x}\, y = 1, \qquad x > 1,$$

find a particular solution for the differential equation

$$x^2\, y'' + xy' + \frac{1}{\ln x}\, y = 2 + \frac{1}{\ln x}, \quad x > 1.$$

2. (a) Given that $y_1(t) = t$ is a solution of the differential equation:

$$t^2\, y'' - t(t+2)\, y' + (t+2)\, y = 0, \qquad t > 0.$$

Reduce the given differential equation into a first order differential equation. **(Do not solve the obtained equation !)**

(b) Given that $y_1 = x\, \cos(\ln x)$ is a solution of the differential equation:

$$x^2\, y'' - x\, y' + 2\, y = 0 \quad \text{on } (0, \infty),$$

find a second solution y_2 that is linearly independent of y_1.

3. Determine the form of a particular solution for the differential equation:

$$y^{(4)} - 4y'' = 5x^2 - e^{2x}.$$

4. Find the general solution of the differential equation :

$$y'' - y = x\, e^{-x}\,(x + \sin^2 x) - 3\,x + 1,$$

by the **undetermined coefficients** method. **(Do not calculate the constant coefficients of the particular solution !)**

5. Solve the differential equation:

$$y'' + 2y' + y = e^{-x} \sec^2 x \, .$$

6. Solve the differential equation

$$y'' + \frac{1}{x^2}\, y = 0, \quad x > 0.$$

7. Find a homogeneous **Cauchy-Euler equation** whose solution is given by:

$$y = c_1\, x^{-2} + c_2\, \cos(2 \ln x) + c_3\, \sin(2 \ln x)$$