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University Examinations 2012/2013

FIRST YEAR, FIRST SEMESTER EXAMINATION FOR MASTER OF SCINECE IN APPLEID MATHEMATICS

SMA 3130: ORDINARY DIFFERENTIAL EQUATIONS I

DATE: AUGUST 2013 **TIME: 3 HOURS**

INSTRUCTIONS: *Answer questions **one** and any other **two** questions*

QUESTION ONE (30 MARKS)

a) One solution of the equation $(x^2-1)y" - 2xy' + 2y = 0$ is y = x. Obtain another independent solution. (6 Marks)

b) Compute the general solution of the differential equation $y" - y' - 2y = e^{3x}\cos 2x$ by the method of undetermined coefficient. (7 Marks)

c) Find the non-trivial solution of the Sturm-Liouville problem $\frac{d}{dx}\left(x\frac{dy}{dx}\right) + \frac{\lambda}{x}y = 0$ where λ is a non-negative parameter. (8 Marks)

d) Solve the Legendre differential equation $(1-x^2)y" - 2xy' + p(p+1)y = 0$, about the ordinary point x=0, where p is given real number. (9 Marks)

QUESTION TWO (20 MARKS)

a) Solve the initial value problem

$$\underset{\sim}{x}' = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & -2 \\ 3 & 2 & 1 \end{pmatrix}\underset{\sim}{x} + \begin{pmatrix} 0 \\ 0 \\ e^t\cos 2t \end{pmatrix}$$

$$\underset{\sim}{x}(0) = \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$$, by the method of variation of parameters.

(12 Marks)

b) Use the method of undetermined coefficients to solve the initial value problem.

$$y''' - 2y'' - y' + 2y = 2x^2 - 6x + 4,\ y(0) = 5,\ y'(0) = -5, y''(0) = 1.$$ (8 Marks)

QUESTION THREE (20 MARKS)

a) Find two solutions of the Bessel equation

$x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+\left(x^2-\frac{1}{4}\right)y=0,0<x<\infty$ (10 Marks)

b) Using the perturbation method, solve the non – linear differential equation

$\frac{dy}{dx}+y=\in y^2, 0<\in\ll 1, y(0)=1$. (10 Marks)

QUESTION FOUR (20 MARKS)

a) Find the general solution of the homogeneous linear system

$$\frac{d\underset{\sim}{x}}{dt}=\begin{pmatrix}3 & 1 & -1\\ 1 & 3 & -1\\ 3 & 3 & -1\end{pmatrix}\underset{\sim}{x}$$ (10 Marks)

b) Solve the non-homogeneous Euler-Cauchy equation

$$x^3y'''-3x^2y''+6xy'-6y=x^4\ln x$$

by the method of variation of parameters. (10 Marks)