National University of Sciences & Technology
School of Electrical Engineering and Computer Science
Department of Basic sciences

MATH-112 Calculus-II (3+0): BSCS-6ABC Spring 2017

Assignment 1: First order differential equations	
CLO1	
Maximum Marks: 70	Instructor: Dr. Hina M. Dutt
Announcement Date: 2 March 2017	Due Date : 9 March 2017

Instructions:

- **This is a group assignment. Each group must have 5 members.**
- **Write names and registration numbers of all group members on the cover page.**
- **Examples must be different from each other or marks will be deducted.**
- **Assignment must be hand written.**
- **Assignments must be properly bound or marks will be deducted.**
- **Copied assignments will be marked zero.**
- **CR of the class will collect all the assignments and submit to the instructor.**
- **Assignments are not acceptable after the deadline.**

Question 1

Write three first order ordinary differential equations in each of the following case:

i. Non-linear and non-homogeneous
ii. Non-homogeneous and separable
iii. Separable and exact

Question 2

Discuss homogeneity and exactness of the equation

$$y - x\frac{dy}{dx} = x + y\frac{dy}{dx}$$

and solve it by two methods.

Question 3

Determine $M(x, y)$ so that the equation

$$M(x, y)dx + \left(xe^{xy} + 2xy + \frac{1}{x}\right)dy = 0$$

is exact.

Question 4

Solve

$$3(1 + t^2)\frac{dy}{dt} = 2ty(y^3 - 1).$$

Question 5

For a series circuit containing only a resistor and an inductor, Kirchhoff's second law states the sum of the voltage drop across the inductor $(L\,{}^{dI}/_{dt})$ and the voltage drop across the resistor (IR) is the same as the impressed voltage $V(t)$ on the circuit, i.e. we have the following differential equation for the current $I(t)$

$$L\frac{dI}{dt} + RI = V(t),$$

where *L* and *R* are constants known as the inductance and the resistance, respectively. Determine $I(t)$ if $R = 6\ Omega, L = 3H, V(t) = 3sint\ V$ and $I(0) = 15(A)$.

Question 6

Suppose a small cannonball weighing 16 pounds is shot vertically upward with an initial velocity $v_0 = 300\frac{ft}{s}$.

a) Suppose air resistance is ignored, determine the velocity of the cannonball at any time t.
b) Using the result obtained in part (a), determine the height $s(t)$ of the cannonball measured from the ground level. Determine the maximum height attained by the cannonball.
c) Assume that air resistance is proportional to instantaneous velocity $v(t)$. Show that in this case the maximum height attained by the cannonball is less than that in part (b), by supposing that the constant of proportionality is $k = 0.0025$.

(The End)