

UNIVERSITY OF DHAKA

Department of Mathematics

Second Year B.S. (Honors) 2019-2020

Subject: Mathematics

Course No: **MTH 250** Course Title: **MATH Lab II**

Assignment-2

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Write a Script file to solve each of the following problems.

- Q1.** (i) Define the following function using ‘syms’

$$f(x) = x^2e^x - 5x^3$$

Compute the integral and first and second derivatives of the above function symbolically.

- (ii) Consider the function

$$f(x, y, z) = x^2e^y - 5z^2$$

Compute the integral with respect to x and second derivative with respect to z.

- Q2.** Solve the first order differential equation using ‘dsolve’ command:

$$\frac{dy}{dx} = xy, \quad y(0) = 1.$$

Plot x vs $y(x)$. Also use ‘ode23’ and ‘ode45’ to solve the equation and plot again.

Extend these ideas for higher order equation.

- Q3.** (i) At time $t = 0$ a tank contains Q_0 lb of salt dissolved in 100 gal of water. Assume that water containing 41 lb of salt/gal is entering the tank at a rate of r gal/min and that the well-stirred mixture is draining from the tank at the same rate. Set up the initial value problem that describes this flow process graphically. Find the amount of salt $Q(t)$ in the tank at any time, and also find the limiting amount Q_L that is present after a very long time. If $r = 3$ and $Q_0 = 2Q_L$, find the time T after which the salt level is within 2% of Q_L . Also find the flow rate that is required if the value of T is not to exceed 45 min.

(ii) The rate at which radioactive nuclei decay is proportional to the number of such nuclei that are present in a given sample. Half of the original number of radioactive nuclei have undergone disintegration in a period of 1500 years.

(a) What percentage of the original radioactive nuclei will remain after 4500 years?

(b) In how many years will 10% of the original number remain?