

## HOMEWORK 10 - MATH 112

DUE DATE: Monday, April 25

INSTRUCTOR: George Voutsadakis

Read each problem very carefully before starting to solve it. One part of each problem will be chosen at random and graded. Each question is worth 1 point. It is necessary to show your work. Correct answers without explanations are worth 0 points.

GOOD LUCK!!

1. Solve the differential equations

(a)  $\frac{dy}{dx} + 3y = e^{-3x}$

(b)  $\frac{dy}{dx} + \frac{2y}{x} = 3x + 1$

2. Solve the differential equations

(a)  $x^3y' + 2y = e^{1/x^2}$

(b)  $xy' + y = x^2 \ln x$

3. Solve the differential equation  $y' + 3x^2y = 3x^2$  subject to the initial condition  $y(0) = 6$ .
4. Solve the differential equation  $x^2y' - 4xy = 10$  subject to the initial condition  $y(1) = 10$ .
5. The rate of change of population of a city is proportional to the population  $P$  at any time  $t$ . In 1993, the population is 400,000 and the constant of proportionality is 0.01. Estimate the population of the city in 2000.
6. A 200-gallon tank is half full of distilled water. At time  $t = 0$ , a solution containing 0.5 pounds of concentrate per gallon enters the tank at the rate of 5 gallons per minute and the well-stirred mixture is withdrawn at the same rate. Find the amount  $Q$  of concentrate in the tank after  $t$  minutes.
7. A wet towel hung from a clothesline to dry loses moisture through evaporation at a rate proportional to its moisture content. If after 1 hour the towel has lost 40% of its original moisture content, after how long will it have lost 80%?
8. When predicting population growth, demographers must consider birth and death rates as well as the net change caused by the difference between the rates of immigration and emigration. Let  $P$  be the population at time  $t$  and  $N$  be the net increase per unit time due to the difference between immigration and emigration. Thus the rate of growth of the population is given by  $\frac{dP}{dt} = kP + N$ ,  $N$  a constant. Solve this differential equation to find  $P(t)$ .