ASSIGNMENT-02

Last Date of Submission: 04-05-2022, 11:59PM, Wednesday (in the Google classroom)
Topic: Separable, Homogeneous, Bernoulli Equations

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01. Solve the differential equation $(x-4)y^4dx - x^3(y^2-3)dy = 0$.

02. Solve the initial value problem $x\sin y dx + (x^2+1)\cos y dy = 0,\ y(1) = \frac{\pi}{2}$.

03. Solve the initial value problem $\left(y + \sqrt{x^2+y^2}\right)dx - xdy = 0,\ \ y(1) = 0$.

04. Solve the differential equation $\frac{dy}{dx} + y = xy^3$.

05. Solve the differential equation $(xy + 2x + y + 2)dx + (x^2 + 2x)dy = 0$.

06. Solve the differential equation $\tan\theta dr + 2rd\theta = 0$.

07. Solve the differential equation $v^3du + (u^3 - uv^2)dv = 0$.

08. Solve the initial value problem (IVP) $8\cos^2 ydx + \csc^2 xdy = 0,\ \ y\left(\frac{\pi}{12}\right) = \frac{\pi}{4}$.

09. Solve the differential equation $\frac{dy}{dx} - \frac{y}{x} = -\frac{y^2}{x}$.

10. Solve the differential equation $dy + (4y - 8y^{-3})xdx = 0$.

11. Solve the differential equation $\frac{dy}{dx} + y = f(x)$, where $f(x) = \begin{cases} 2, 0 \le x < 1 \\ 0, x \ge 1 \end{cases}$, $\ y(0) = 0$.

12. 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 numbers 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 only one-tenth of the original number remain?

13. The population x of a certain city satisfies the logistic law

$$\frac{dx}{dt} = \frac{1}{100}x - \frac{1}{(10)^8}x^2$$

where time t is measured in years. Given that the population of this city is 100,000 in 1980, determine the population as a function of time for t > 1980. In particular, answer the following questions:

(a) What will be the population in 2000?
(b) In what year does the 1980 population double?
(c) How large the population ultimately be?

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