

ES.1803 Problem Section 1, Spring 2024

Problem 1.1. (From Topic 1 notes.) Solve $y' + p(x)y = 0$.

Problem 1.2. You deposit money in a bank at the rate of \$1000/year. The money earns (continuous) 8% interest. Construct a DE to model the amount of money in the bank as a function of time; then solve the DE. Assume that at time 0 there is no money in the bank.

Problem 1.3. Consider the family of all lines whose y -intercept is twice the slope.

(a) Find a DE which has this family as its solutions.

(b) Find the orthogonal trajectories to the curves in Part (a). That is, find a family of functions whose graphs intersect all the lines in Part (a) orthogonally.

(c) Sketch both families.

Problem 2.4. (Linear inhomogeneous)

(a) Solve $y' + 2y = 2$.

(b) Solve $y' + 2y = 2t$.

(c) Solve $y' + 2y = 5 + 2t$ using the earlier parts of this problem and superposition.

Only do Parts a and b.

Problem 2.5. Solve $y' + 2y = 2$; $y(1) = 1$.

Extra problems if time.

Problem 2.6. (Linear homogeneous)

(a) Solve $y' + ky = 0$.

(b) Solve $y' + ty = 0$.

Problem 1.7. Solve $y' = \sin(x^2)$, $y(0) = 1$. Give the solution as a definite integral. (Note, you can't do the integral, but the solution is perfect for numerical computation by computer.)

Problem 1.8. (Here's the second geometry example in the notes for Topic 1.)

$y = y(x)$ is a curve in the first quadrant. The part of the tangent line in the first quadrant is bisected by the point of tangency. Find and solve the DE for this curve.

Problem 1.9. Solve $y' = f(x)$, $y(a) = y_0$.

Problem 1.10. Solve $\frac{du}{dt} = \sin t \cos^2 u$, $u(0) = 0$.

Problem 1.11. (From Topic 1 notes.) Solve $\frac{dy}{dx} = xy$.

Problem 1.12. (From Topic 1 notes.) Solve $\frac{dy}{dx} = x^3y^2$.

Problem 2.13. (IVP using definite integrals)
Solve $xy' - e^x y = 0$, $y(1) = 2$ using definite integrals.

Problem 2.14. Show that $y' + y^2 = q$ does not satisfy the superposition principle.

MIT OpenCourseWare

<https://ocw.mit.edu>

ES.1803 Differential Equations

Spring 2024

For information about citing these materials or our Terms of Use, visit: <https://ocw.mit.edu/terms>.