In the name of God

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NUMERICAL ANALYSIS COURSE

Exercise Set 8

(Due Date: 1403/09/20)

1. Implicit and Explicit methods for solving differential equation:
A: Suppose that $f' \equiv \frac{df(x)}{dx} = f^2(x)$ and step size $\Delta x = 0.5$ and $f(x = 1) = 1$. Use explicit and implicit approaches to compute $f(x)$. Compare your results.
B: Suppose that $f' \equiv \frac{df(x)}{dx} = -f(x)$ and step size $\Delta x = 0.5$ and $f(x = 1) = 1$. Use explicit and implicit approaches to compute $f(x)$. Compare your results.

2. Using Euler and RF4 methods
A: Solve following initial value problem:

$$y''(t) + ay'(t) + \omega^2 y(t) = \cos(\omega_1 t)$$

with $y(0) = A$, $y'(0) = 0$ and take any arbitrary values for other free parameters. Plot the phase diagram, namely $y'(t)$ as a function of $y(t)$.
B: Use the Mathematic to solve mentioned equation and compare your result with that determined by Mathematica.

3. Chaotic oscillation: suppose the following equation:

$$\frac{d^2\theta}{dt^2} = -\omega_0^2 \sin\theta - \alpha\frac{d\theta}{dt} + f\cos(\omega)$$

where $\omega_0 = 1$, $\alpha = 0.2$, $f = 0.52$ and $\omega = 0.666$. Plot phase diagram and $\left|\frac{d\theta}{dt}\right|$ as a function of driving force f. (You can use the Mathematica to solve it)

4. Lorenz attractor: suppose following coupled equations:

$$\frac{dx}{dt} = 10(y - x)$$

$$\frac{dy}{dt} = -xz + 28x - y$$

$$\frac{dz}{dt} = xy - \frac{8}{3}z$$

Solve them and plot phase diagram of each of them. (You can use the Mathematica to solve them)

Good luck, Movahed