**Class 26** – **Boundary Value ODEs (Chp. 24)**

ChE310\_Sec1\_F2019 / 11.21.19

<http://www.reuelgroup.org/numerical-methods-che-310.html>

Announcements:

* Phase II memo returned. Class project due 12.10 for demo!
* Thanksgiving break! Have a good safe one. Sleep!
* Dec 3 – Recorded Lecture (Reuel flying to Boston)
* Dec 5 – Prof. Roling practice of ODE
* Final is Dec. 19 from 7:30 to 9:30 AM

**Warm Up Group Activity:** submit to Slack by **2:25 pm**.

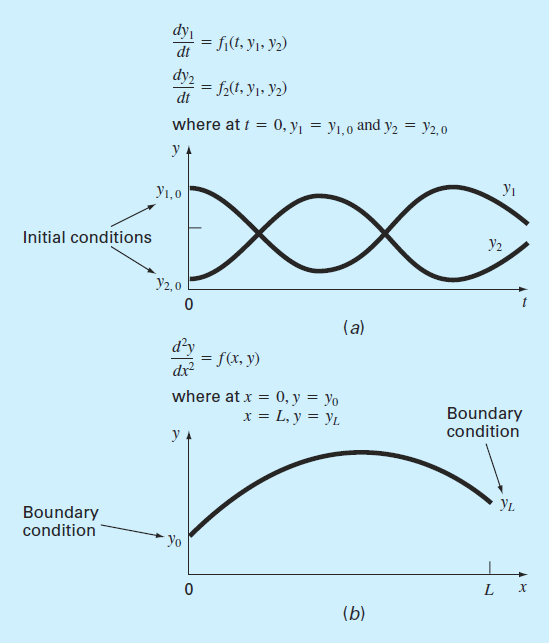
Solve the following ODE and plot solutions with:

1. Analytical method
2. Using a 2nd order RK method of your choice
3. Using the 4th order RK method (code your own)

 y(0) = 1

**Outline for Class 27 Lecture**

1. Boundary Value Problems vs. IVP



Boundary values

* + Constants (*Dirichlet Boundary Conditions)*
  + Rates (flux, gradient, insulated)
  + *Neumann Boundary Conditions*
  + Two ways to solve numerically:
  + Shooting method
  + Finite difference method (mesh w/ nodes)

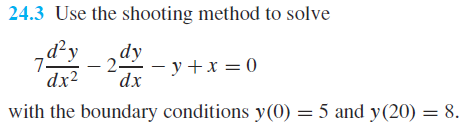
1. Shooting Method

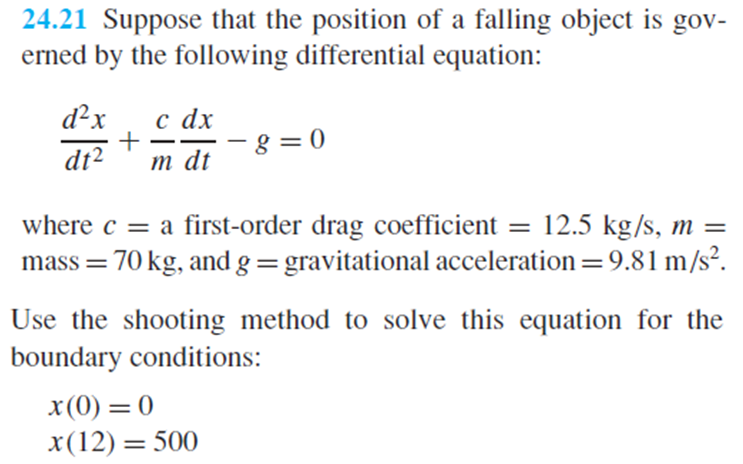
“For linear ordinary differential equations can use interpolation. For nonlinear you can use root finding.”

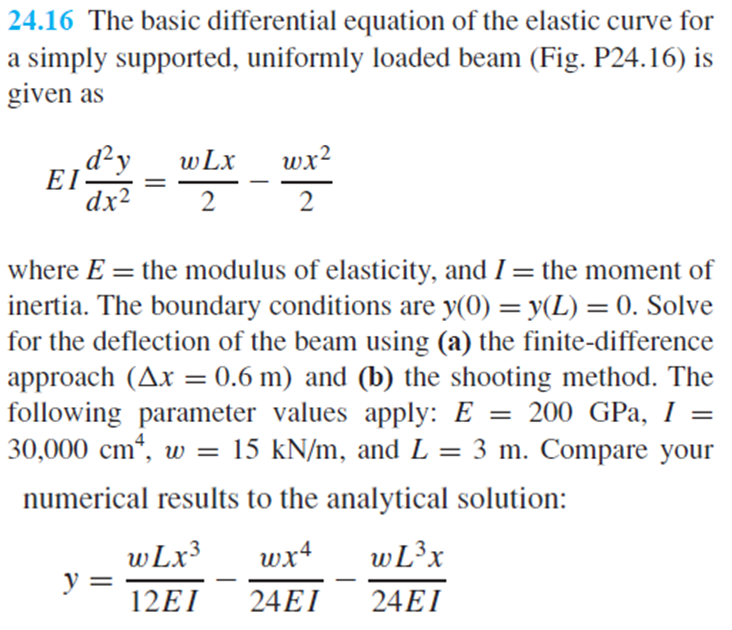
DEMO - <https://phet.colorado.edu/sims/projectile-motion/projectile-motion_en.html>

(interpolation as linear, doesn’t work w/ air resistance)

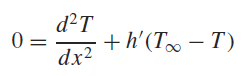
Examples:





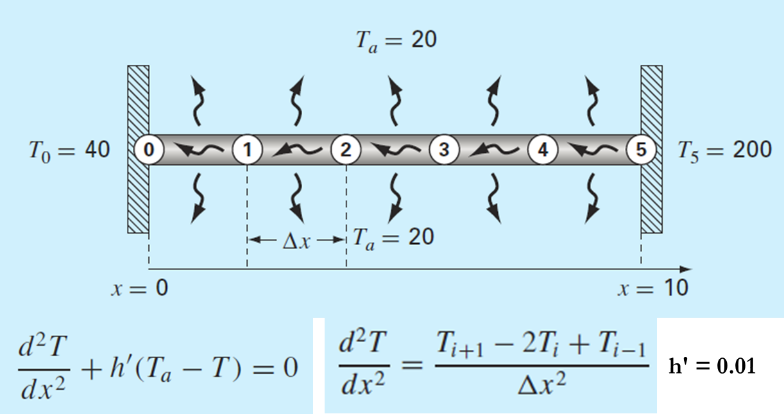


1. Finite Difference Method: ODE🡪 sys of eqns.

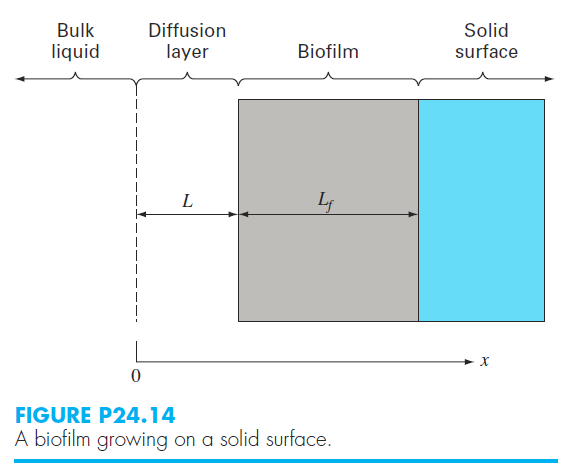


* 1. These result in sparse matrices (**tridiag**)

Example (return to the heated rod)



Another example of Neumann Boundary value problem solved with finite difference method (24.14)

24.14 (book)