MATHEMATICS 4162
NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS

The diffusion equation

$$\frac{\partial u}{\partial t}(x,t) = \alpha^2 \frac{\partial^2 u}{\partial t^2}(x,t), \quad 0 < x < 1, \quad t > 0$$

subject to

$$u(0, t) = 0, \; u(1, t) = 0, \; t > 0, \; u(x, 0) = f(x), \; 0 < x < 1$$

is to be discretized using forward finite differences of order one for $\partial u/\partial t$(with step size k) and central differences of order two for $\partial^2 u/\partial t^2$ (with step size h). How should the step sizes h and k be chosen so as to assure the scheme is stable? What's the accuracy of the method?

MATH 4162 is numerical analysis tailored to the treatment of differential equations by computers. The course will be include numerical solution of initial value problems for ordinary differential equations by single and multi-step methods, finite difference methods and a brief look at finite element techniques. Once again, our focus is on the theory surrounding numerical methods, not just their formal descriptions.

Text. Suitable textbook for this course might be *Numerical Methods for Differential Equations* by Michael Celia and William Gray.

Marks. While the exact formula may vary from semester to semester, it is typical to assign 50% to term work and the remaining 50% to a final exam.

Calendar description. **4162 Numerical Methods for Differential Equations** covers numerical solution of initial value problems for ordinary differential equations by single and multi-step methods, Runge-Kutta, and predictor-corrector; numerical solution of boundary value problems for ordinary differential equations by shooting methods, finite differences and spectral methods; numerical solution of partial differential equations by the method of lines, finite differences, finite volumes and finite elements.
Prerequisite: Mathematics 3132 and 4160.

Offered. Winter