# Assignment III

## Spring 2006

INSTRUCTIONS:

- There are five problems in this assignment.
- You will be graded on how you arrived at the answers. **Show all your work**.
- Deadline: 1:00 p.m. on Monday, May 1, 2006. A hard copy of the report is required.

**1.** State the differences between the bisection, Newton's and secant methods for solving the nonlinear equation $f(x) = 0$ over an interval $a \leq x \leq b$.

**2.** Is there a cubic polynomial that takes the following values?

| $x$ | 1 | -2 | 0 | 3 | -1 | 7 |
|---|---|---|---|---|---|---|
| $y$ | -2 | -56 | -2 | 4 | -16 | 376 |

**3.** Let $Ax = b,\ A \in \mathbb{R}^{n\times n}$, be a system of $n$ linear equations. State the steps of Gaussian elimination with scaled partial pivoting for solving the system.

**4.** Consider the following IVP:

$$x'(t) = f(t, x(t)),\ t > a; \quad x(a) = x_0,$$

and a set of distinguished numbers

$$a = t_0,\ t_1,\ t_2,\ \ldots, t_n, \ldots,$$

where $1 > t_k - t_{k-1} = h_k > 0,\ k = 1, 2, \ldots$, and $a,\ x_0$ are real constants. State the forward, backward Euler methods and central difference method for solving the IVP, respectively. Are these difference schemes implicit? Why or why not?

**5.** Let

$$x''(t) = f(t, x(t), x'(t)),\ t > a; \quad x(a) = \alpha,\ x'(a) = \beta,$$

be a given second order IVP, where $a,\ \alpha$ and $\beta$ are real constants and $f$ is sufficiently smooth. Show that we can solve the IVP by using a second order Runge-Kutta method.