بسم ا الر ن الرحيم

DEPARTMENT OF CIVIL ENGINEERING - KFUPM

Numerical and Statistical Methods in Civil Engineering

CE 318 -1-'11 (111)

Assignment NO. 4

Subjects: **Numerical Solutions of Nonlinear equations and Matrix Linear Equations**

DUE DATE: **Nov. 22, '11**

1. Use the **Newton-Raphson Method** to determine the roots for the following two problems with errors in the computed roots *not* more than 0.5%.

   i) Solve parts (a) and (b) of problem 6.10 [textbook page 158] starting from $x_i = 0.2$;

   ii) Solve problem 6.13 after re-writing (*re-arranging*) the nonlinear equations as

   $$u\ (x,y) = 0.$$
   $$v\ (x,y) = 0.$$

2. Use the method of **Gauss Elimination** to solve textbook Problem 9.11 [textbook page 262]. Also compute the determinant of the coefficient matrix and check the accuracy of your results $\boldsymbol{x}^*$ by substitution in $\mathbf{A}\ \boldsymbol{x}^* = \boldsymbol{b}^*$ and computing the ratio of norms of vectors $\Delta\boldsymbol{b}$ and $\boldsymbol{b}$ (*namely*: $\frac{\|\Delta \mathbf{b}\|}{\|\mathbf{b}\|}$).

3. Determine the inverse of matrix $\boldsymbol{A}$ (given in textbook Problem 10.9 [textbook page 284]), and also determine its three matrix **norms** $\|A\|_1, \|A\|_e, \|A\|_\infty$.

4. Compute the **condition number** for the matrix given in textbook Problem 10.9. *Also*, check if the matrix is ill-conditioned or not. Then if it is ill-conditioned *specify the number of significant digits that will be lost* due to ill-conditioning.

5. Use LU-decomposition (i.e. **Cholesky decomposition**) to solve textbook Problem 11.5 [textbook page 303] such that the RHS-vector of matrix equation $\boldsymbol{A}\ \boldsymbol{x} = \boldsymbol{b}$ is modified to be $\boldsymbol{b} = [100, 250, -50]^T$.

6. Use **Gauss-Seidel iterative** procedure to solve textbook Problem 11.8 with an *initial* solution vector $\mathbf{c}_o = [30,\ 15,\ 10]$. Stop iterations when the *percent relative error* in solution vector is less than 2%.