ME 504 Numerical Methods for Engineering Computation Marks 25

Assignment 4

(Eigenvalue Problem and System of Nonlinear Equations)

Q1. Use Matlab/Octave to compute eigenvalues (only and not eigenvectors) of a random 5 x 5 matrix by direct use of *eig* command (Random matrix can be generated by *rand(n,n)* command). Further use command *poly* (to obtain characteristic polynomial) and *root* command to calculate eigenvalue through characteristic polynomial coefficients. Compare the time required in two methods to calculate eigenvalues. Calculate the norm of difference in two eigenvalues (using *norm* command).

What happens when size of matrix is changed to 500 x 500 and 1000 x 1000 with respect to computational time and the norm of difference/error. [6]

Q2. Create an *n x n* matrix with tridiagonal structure and nonzero elements (-1 , 2 , -1) in each row. For *n* = 5 find all eigenvalues and verify that they are $2-2\cos\left(j\frac{\pi}{n+1}\right)$. You can directly use eig function. [6]

Q3. Use power method method to find eigenvalue and associated eigenvectors for following matrices with given initial guess. Verify your results with eig function. You may want to code power method with and without normalizing iterative eigenvectors.

a. $\begin{bmatrix} .9901 & .002 \\ -.0001 & .9904 \end{bmatrix}$, $x^0=[1,0.9]^T$

b. $\begin{bmatrix} 8 & -1 & -5 \\ -4 & 4 & -2 \\ 18 & -5 & -7 \end{bmatrix}$, $x^0=[1,0.8,1]^T$ [3+3]

Q4. Solve for the system of equation

$$x^3-2xy+y^7-4x^3y=5$$
$$y\sin(x)+3x^2y+\tan(x)=4$$

a) Eliminate *y* from two equations and solve a single scalar nonlinear equation using newton method with initial value 1.

b) Solve the system of nonlinear equation directly [2+5]