# COLLEGE OF ENGINEERING & TECHNOLOGY

**Department: Electronics and Communications Engineering**

**Instructor: Dr. Amr Bayoumi**

**Course Title: Advanced Engineering Mathematics**

**Course No.: EC738** **Problem Set #2a,b**

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## Eigenvalue Problems (Analytical)

1. Using polynomial method, find the eigenvalues and eigenvectors for:

   a) $A = \begin{bmatrix} 1 & 4 \\ -5 & -5 \end{bmatrix}$

   b) $A = \begin{bmatrix} 3 & -1 & 7 \\ -1 & -1 & 1 \\ 7 & 1 & 3 \end{bmatrix}$

   c) In problem 1b, prove that the sum of eigenvalues equals the trace of the matrix (the trace of a matrix is the sum of the diagonal components)

2. For the mass-spring system given in lecture, find natural frequencies and eigenvectors if the mass is 20Kg, k=100N/m. Sketch the displacement of each mass as a function of time

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## Eigenvalue Problems (Numerical: Finite Difference/Polynomial Method)

3. For the problem in lecture 3 (Schrodinger Equation for a 1D infinite potential well, use four internal nodes:
   a. Write down the new matrix equation
   b. Use the polynomial method the approximate the 4 eigenvalues
   c. Show the % error w.r.t. analytical solution, and compare with errors for 2-node & 3-node solutions given in lecture.

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## Part B

## Eigenvalue Problems (Iterative: Power Method)

4. For problem 1b, use the power method (3 iterations only) to find the eigenvalue with the largest absolute value, and the corresponding eigenvector. Compare with analytical results.

5. For problem 1b, use the inverse power method (3 iterations only) to find the eigenvalue with the smallest absolute value, and the corresponding eigenvector. Compare with analytical results.

Note that the LU factorization needs to be calculated only once, since only the right hand side *(RHS)* vector changes after each iteration.