Sample Final

**Duration:** 4 questions, 100 Minutes

closed notes/books, you can use a handwritten A4 size cheatsheet, please show your work

Name:..................................
ID#:.................................

**Question 1 [35pts]:** Consider the Simultaneous Subspace (or Vector) iterations for finding k-smallest eigenvalues and the corresponding eigenvectors. Assuming small $k$, what is the most time consuming operation? Find the sequential and parallel cost of this operation assuming the matrix is banded with a bandwidth $b$. 
**Question 2 [14pts]:** What is the main difficulty involved in parallelism using multisec- tioning technique for solving eigenvalue problems? What are some of the solutions to these problems?
Question 3 [35pts]: Consider the Gauss-Seidel iterative scheme for solving a linear system \( Ax = b \):

\[ x_{i+1} = (D + L)^{-1}(-Ux_i + b) \]

in which \( D, L, \) and \( U \) represent the diagonal, strictly lower triangular, and strictly upper triangular parts of \( A \), respectively. Assuming \( A \) is a banded matrix, provide the partitioning of the data and parallelize the Gauss-Seidel iterations.
Question 4 [16pts]: Are the following true or false?

(a) Spectral graph portioning requires computing all the eigenvalues of the Laplacian matrix. [ T / F ]

(b) Dynamic load balancing is always better than static load balancing. [ T / F ]

(c) Partitioning required for the Parallel sparse DS factorization is the same as partitioning required for sparse matrix vector multiplication [ T / F ]

(d) We can not represent skew symmetric (i.e. \( A^T = -A \)) matrices as graphs. [ T / F ]