1. Determine whether the given pair of graphs is isomorphic. Exhibit an isomorphism or provide a rigorous argument that none exists.
2. Prove by induction that $n^2 - 7n + 12$ is nonnegative whenever $n$ is an integer with $n \geq 3$. 
3. (a) How many vertices and how many edges are in $K_n$ for $n > 2$?
(b) For which $n$ does $K_n$ (for $n > 2$) have a Euler circuit? Justify your answer.
(c) For which $n$ does $K_n$ (for $n > 2$) have a Hamilton circuit? Justify your answer.
(d) How many vertices and how many edges are in complete bipartite graph $K_{m,n}$ for $m, n > 1$?
(e) For which $n$ does complete bipartite graph $K_{m,n}$ (for $m, n > 1$) have a Euler circuit? Justify your answer.
(f) For which $n$ does complete bipartite graph $K_{m,n}$ (for $m, n > 1$) have a Hamilton circuit? Justify your answer.
4. For the web graph shown below write the link matrix $A$ that expresses the system of PageRank linear equations in the form $Ax = x$, where $x = [x_1 \ x_2 \ x_3 \ x_4 \ x_5]^T$.

Is the matrix $M = (1 - m)A + mS$ for $m=0.25$ column-stochastic? Justify your answer.

![Web Graph Diagram]
5. Use the method of Gaussian elimination to find $x$ for the system of linear equations $Ax=b$, where $A$ and $b$ are given below. Show your work.

$$A = \begin{bmatrix} 2 & 4 & 6 \\ 1 & 3 & 5 \\ 2 & 6 & 11 \end{bmatrix}, b = \begin{bmatrix} 10 \\ 4 \\ 6 \end{bmatrix}$$
6. Use method of Gaussian elimination to find the determinant of matrix \( B \) given below. Show your work.

\[
\begin{bmatrix}
0 & 1 & 2 \\
-1 & 1 & 3 \\
2 & -2 & 0
\end{bmatrix}
\]
7. Find the eigenvalues and the eigenvectors of these two matrices. Show your work.

\[ A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix} \quad \text{and} \quad A + I = \begin{bmatrix} 2 & 4 \\ 2 & 4 \end{bmatrix} \]
8. Find the eigenvalues and the eigenvectors of matrix $A$. Show your work.

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 2 & 0 \\ 2 & 3 & 3 \end{bmatrix}.$$
9. Find the matrix $A$ that performs those transformations, in order, on the Cartesian plane. To which point is the point \((-2, 1)\) mapped by this transformation.
   (a) horizontal stretch by a factor of 3
   (b) reflection across the line $y = x$
10. Find the standard matrix $A$ for the given linear transformation $T$.

$$
T \left( \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \right) = \begin{bmatrix} x_1 + 2x_2 - 3x_3 \\ 0 \\ x_1 + 4x_3 \\ 5x_2 + x_3 \end{bmatrix}
$$
11. Provide a pseudo code of an algorithm for finding the second largest number in a sequence of $n$ distinct integers ($n > 1$) distinct integers. What is its worst-case time complexity in the terms of the number of comparisons? Justify your answer.
12. Let \( f(n) = 2n \log(n^2 + 3) + 7n + 5 \). What is big-O estimate of \( f(n) \)? Be sure to specify the values of the witnesses \( C \) and \( k \).