2004/10/13	**M174 : Numerical Methods in Science and Engineering**	
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Name _____ Student #_____

Instructions: Read all instructions carefully. Write your name and student number above. Clearly indicate your answers & show all your work. For many problems partial credit is available. 6 Problems worth 30 Points.

Problems. Show all work on your answer sheets. Partial credit is available.

P1 (**5 pnts**) Clearly state Taylor's Theorem for $f(x+h)$. Include all hypotheses, and state the conditions on the variable that appears in the error term.

P2 (**5 pnts**) Give a $\mathcal{O}\left(h^3\right)$ approximation to $\ln(1+h)$. Suppose that h is restricted to be in $[-0.5, 0.5]$ How big could the error be?

P3 (**5 pnts**) Rewrite the expression $1-\cos x$ to eliminate subtractive cancelling when x is small. (*Hint:* you need not use Taylor's Theorem, as the simpler technique suffices.)

P4 (**5 pnts**) Find the LU decomposition of the following matrix by Gaussian Elimination with naïve pivoting.

$$\begin{bmatrix} 2 & 4 & 10 \\ 6 & 14 & 20 \\ -4 & -2 & -17 \end{bmatrix}$$

P5 (**5 pnts**) Suppose the eigenvalues of the 3×3 matrix A are $1, 3, 20$. Give an eigenvalue of

$$\mathsf{B} = \mathsf{A}^2 - 2\mathsf{A} - 3\mathsf{I},$$

where I is the identity matrix. Is the matrix B singular? Why or why not?

P6 (**5 pnts**) Write the general form of the iterated solution to the problem

$$\mathsf{A}\boldsymbol{x} = \boldsymbol{b}.$$

Let Q be your "splitting matrix," and use the factor ω. Your solution should look something like:

$$??\boldsymbol{x}^{(k)} = ??\boldsymbol{x}^{(k-1)} + ?? \qquad \text{or} \qquad \boldsymbol{x}^{(k)} = ??\boldsymbol{x}^{(k-1)} + ??$$

For one of the following variants, describe what Q is, in relation to A : Richardson's, Jacobi, Gauss-Seidel.