Computational Methods in Structural Dynamics, Exam 1 Winter 2001
One 8.5" by 11" cheat sheet.

1. (10 points) Use first order perturbation methods to estimate the eigenvaluesof B given

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 3 & -1 \\ 0 & -1 & 4 \end{bmatrix}, \quad \Lambda = \begin{bmatrix} 1.2679 & 0 & 0 \\ 0 & 3.0000 & 0 \\ 0 & 0 & 4.7321 \end{bmatrix}, \quad \Phi = \begin{bmatrix} 0.7887 & 0.5774 & 0.2113 \\ 0.5774 & -0.5774 & -0.5774 \\ 0.2113 & -0.5774 & 0.7887 \end{bmatrix}$$

when

$$A = \begin{bmatrix} 2.01 & -1 & 0 \\ -1 & 3 & -1 \\ 0 & -1 & 4 \end{bmatrix}$$

2. (10 points) Use Hamilton's principal to derive the equations of motion for the following system. A uniform cantilever beam has torsional stiffness GJ, vertical bending stiffness EI, and mass per unit length ρA, and rotational inertia (twisting) per unit length ρI_p (I_p being the polar moment of inertia for the twisting beam). The beam is cantilevered at the left end, and a massless rigid bar BC is attached at the right end. A concentrated mass is located at the end of the rigid/massless beam. Assume that bending takes place only in the $y - x$ plane with deflection $v(x,t)$ and that rotation takes place about the x axis ($\theta(x,t)$). Neglect gravity. State the equation/s of motion and boundary conditions. The potential energies are given by

$$V_{twist} = \frac{1}{2}\int_0^L GJ\left(\frac{\partial \theta}{\partial x}\right)^2 dx, \qquad V_{bending} = \frac{1}{2}\int_0^L EI\left(\frac{\partial v}{\partial x}\right)^2 dx$$

Do not attempt to solve the equations of motion.