Membrane and Plate Problems

AE 6230
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1. A uniform square membrane has repeated natural frequencies $\omega_{mn} = \omega_{nm}$. Any linear combination of the modes W_{mn} and W_{nm} is also a mode. Plot the nodal lines for the mode

$$W(x, y, c) = W_{13}(x, y) + cW_{31}(x, y)$$

for the values $c = 0, \frac{1}{2}, 1$.

2. Solve the eigenvalue problem for a uniform annular membrane defined over the domain $b < r < a$ and fixed at $r = a$ and $r = b$.

3. Modify the derivation of the generic boundary conditions for a vibrating plate so as to accommodate the case in which the displacement w at every point of the boundary is restrained by a distributed vertical translational spring of stiffness k.

4. Solve the eigenvalue problem for a uniform circular plate simply supported all around.