Vibrations of Structures

Module IV: Vibrations of Membranes

Exercises

1. Determine the eigenfrequencies and modes of vibration of a right isoceles triangular membrane of hypotenuse $\sqrt{2}\,a$ that is fixed at all the boundaries.

2. Determine the eigenfrequencies and modes of vibration of an annular membrane that is fixed at the boundaries $r = a$ and $r = a/2$.

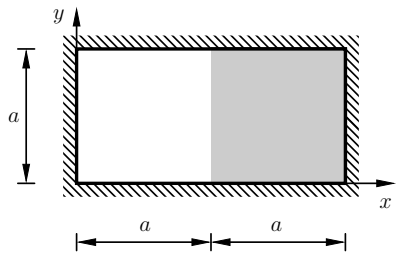

Figure 1: Exercise 3

3. A rectangular membrane of width a and length $2a$ is made of two materials of mass densities μ_1, and μ_2 which are joined together, as shown in Fig. 1. Derive the characteristic equation and determine the eigenfrequencies and eigenfunctions.

4. A circular membrane of radius a with fixed boundary has a small particle of mass m attached at the center. Estimate the eigenfrequencies of the membrane.

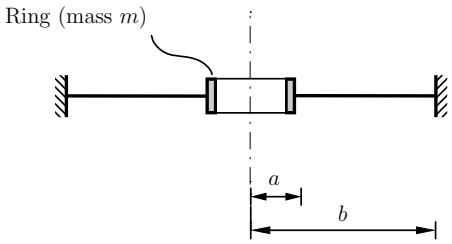

Figure 2: Exercise 5

5. An annular membrane of density μ and uniform tension per unit lenght T is fixed at the outer radius b, and connected to a thin ring of mass m and radius a, as shown in Fig. 2. Determine the approximate eigenfrequencies and modes of vibrations of the system.

6. A composite circular membrane over a hemispherical enclosure (a kettledrum) consists of a central circular membrane of radius a and mass density μ_1, and an annular membrane of mass density μ_2 between the radii a and b. Assuming a uniform tension per unit length T, determine the approximate eigenfrequencies and modes of vibrations of the drum.