

## **MAE 82 – Project Solution**

### **Bessel Equation**

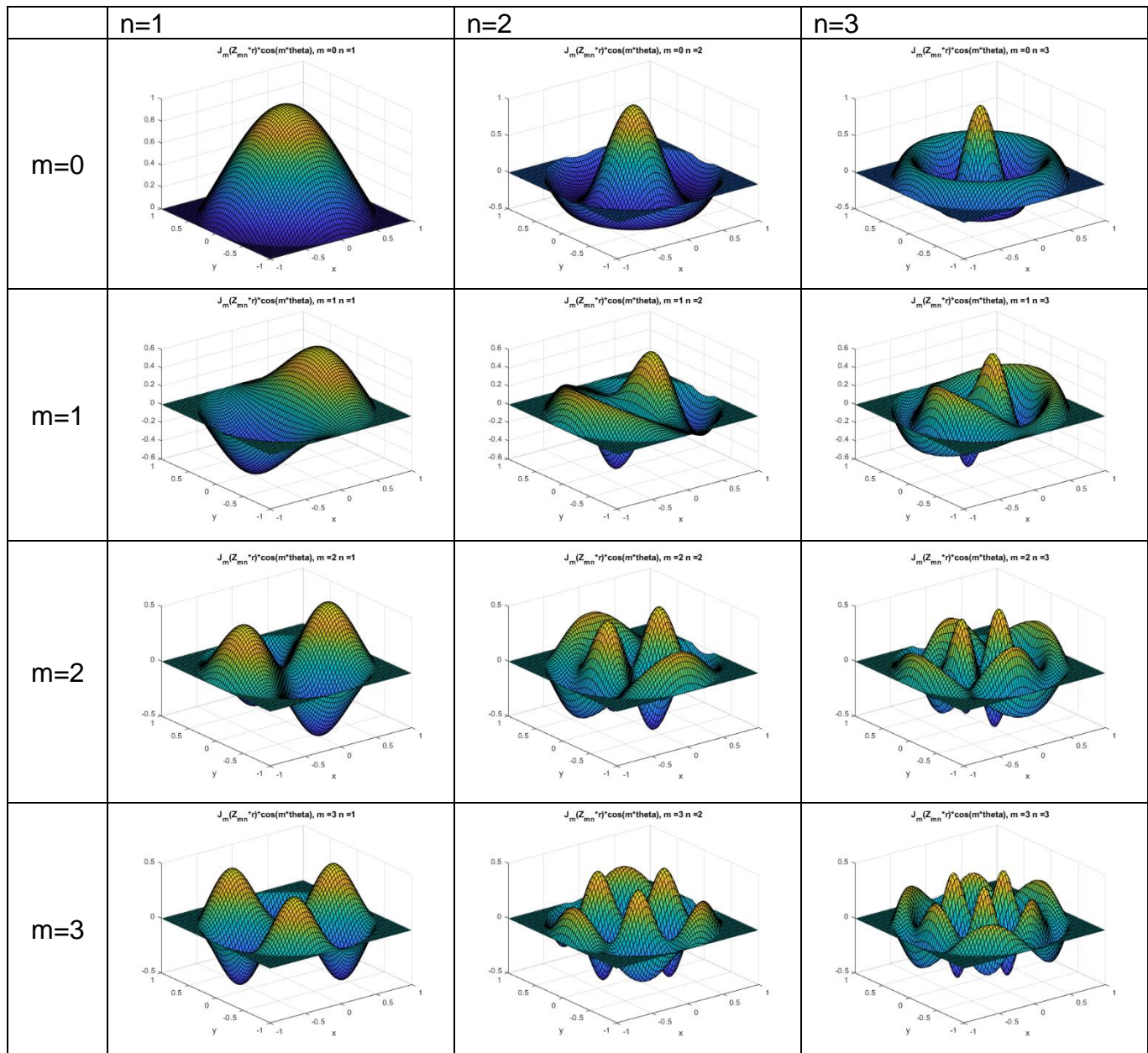
The Wave Equation in Polar Coordinate System

Vibration of a Membrane - Circular Drum Head

3. (a) Generate 12 plots of the following term

$$J_m(Z_{m,n}r) \cos(m\theta)$$

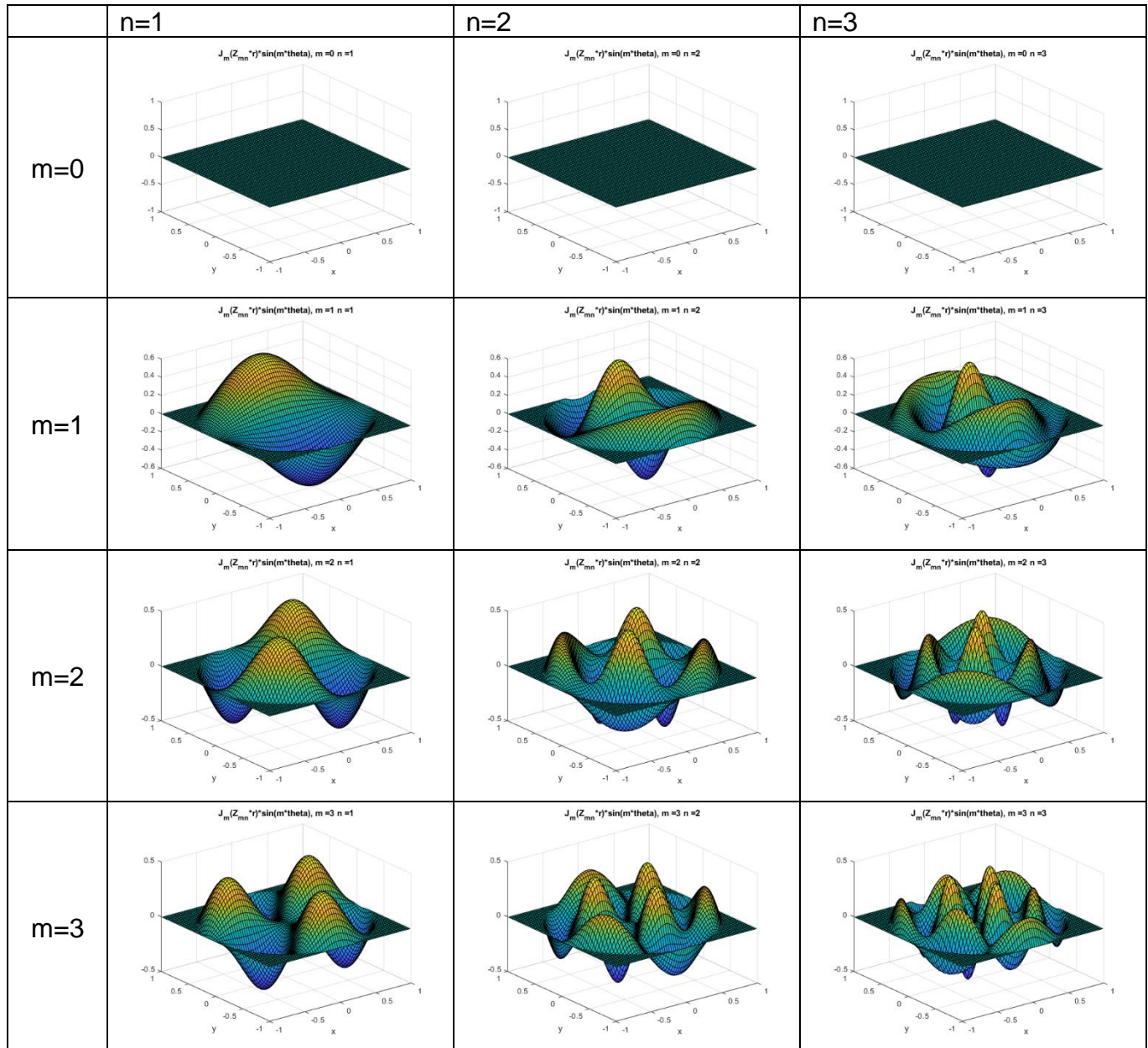
For  $r: 0 \rightarrow 1, \theta: 0 \rightarrow 2\pi, m = 0,1,2,3, n = 1,2,3$



3. (b) Generate 12 plots of the following term

$$J_m(Z_{m,n}r) \sin(m\theta)$$

For  $r: 0 \rightarrow 1, \theta: 0 \rightarrow 2\pi, m = 0,1,2,3, n = 1,2,3$



4. What is the relationships between the two terms?

The sine terms are rotated by 90 degrees relative to the cosine terms.

5. What do they represent?

Any drum vibration can be expressed with combinations of the sine and cosine terms.