FORMULA CHECKLIST FOR ENGINEERING APPLICATIONS

For a lamina occupying a region D with density function $\rho(x, y)$, we have the following formula used in applications:

Total mass M of the lamina is

$$M = \int\int_D \rho(x, y)\ dA$$

First moments of the lamina:
about the x-axis is

$$M_x = \int\int_D y\rho(x, y)\ dA,$$

about the y-axis is

$$M_y = \int\int_D x\rho(x, y)\ dA.$$

Centre of mass (x_m, y_m) of the lamina is:

$$x_m = \frac{M_y}{M} = \frac{\int\int_D x\rho(x, y)\ dA}{\int\int_D \rho(x, y)\ dA}$$

$$y_m = \frac{M_x}{M} = \frac{\int\int_D y\rho(x, y)\ dA}{\int\int_D \rho(x, y)\ dA}.$$

Centroid $(\bar{x}, \bar{y})$ of D ($\rho =$ constant) is:

$$\bar{x} = \frac{\int\int_D x\ dA}{\int\int_D\ dA},$$

$$\bar{y} = \frac{\int\int_D y\ dA}{\int\int_D\ dA}.$$

Moments of Inertia of the lamina:
about the x-axis is

$$I_x = \int\int_D y^2\rho(x, y)\ dA,$$

about the y-axis is

$$I_y = \int\int_D x^2\rho(x, y)\ dA,$$

Polar moment of inertia of the lamina about the origin is:

$$I_0 = I_x + I_y = \int\int_D (x^2 + y^2)\rho(x, y)\ dA,$$