Design Decisions – Reaction Wheel Module

This reaction wheel system was designed to be compact, 3D-printable, and modular, suitable for integration into a CubeSat-class spacecraft. The following key design decisions were made:

- **Volume Optimization:**
  The entire assembly was constrained to fit within a 60 mm x 60 mm x 69 mm housing, keeping the total volume under the specified 250 cm^3 limit. This ensured compatibility with satellite form factor requirements.
- **Flywheel Geometry:**
  A 50 mm diameter flywheel with 8 mm thickness was selected to maximize moment of inertia while ensuring adequate clearance within the enclosure. The flywheel was designed for uniform mass distribution and rotational balance.
- **Gear-Based Torque Transmission:**
  A gear system was used between the DC motor and the flywheel shaft. A 10-tooth external gear drives a 24-tooth internal gear, resulting in torque amplification, ideal for generating controlled angular momentum.
- **Motor Mounting and Axis Offset:**
  The DC motor is mounted 3.5 mm off-center to accommodate the gear mesh with the internal gear. The motor mount was custom-modeled to ensure tight fitment and structural rigidity, while allowing for proper shaft alignment.
- **Material Selection:**
  All components were modeled using ABS plastic (as defined in SolidWorks), representing realistic 3D-printing material properties. This allowed accurate mass and inertia calculations throughout the design process.
- **Printability Focus:**
  Every part was intentionally designed with **zero overhangs**, eliminating the need for support structures during 3D printing. All geometries are clean and self-supporting, ensuring straightforward and efficient fabrication.

This design prioritizes balance, printability, and functional performance, laying the groundwork for reliable attitude control when paired with embedded control logic and sensing systems.