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- 1) Consider the vertical ascent of a rocket having initial mass  $m_0$  in a constant gravity field  $g$ , powered by an engine with specific impulse  $I_{sp}$  burning fuel at a constant rate  $\dot{m}_e$ . Obtain an expression for the altitude  $h(t)$  during powered flight.
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- 2) The Hubble Space Telescope, launched on April 24, 1990, is currently in a 283 nautical mile high circular orbit. The telescope is a cylindrical shaped structure 14 ft diameter x 42.5 ft long. Two solar panels each measuring 10 ft x 40 ft are mounted radially on opposite sides of the cylindrical body. The total weight of the spacecraft is 27,000 lbs. Estimate the orbital lifetime of the satellite.
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- 3) The International Space Station is in a nearly circular orbit of 420 km altitude and inclination of  $51.6^\circ$ . What is the spacing in kilometers between successive ground tracks at the equator, (a) assuming the earth is perfectly spherical, and (b) including the effect of the earth's oblateness. Check your results by performing a 10-hour simulation using GMAT with and without the J2 propagator. Print out the output of your simulations and comment on your results.
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