Spaceflight Dynamics

POA SOS 2020

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Timeline:
Week 1 : Brush up on basic kinematic equations and dive deeper into the initial maths (change of origin, rotation and translation in various coordinate systems, quaternion rotation) required to set foundation for further mathematical analysis. Along with that, learn more about how to use LaTex.

Week 2: Look into the base physics required - particle dynamics, rigid body dynamics, two body problem.

Week 3: Learn about aerodynamic aspects of rockets, the factors affecting them both in Earth atmosphere as well as in space. The underlying physics and corresponding mathematical treatment of the same.

Week 4: Learn more about the space environment - radiation effects, maintaining temperature, meteors, meteorites, magnetic mirrors etc.

Week 5: Learning about the propulsion techniques employed, launch sequences, the problems faced and how they are overcome. The multistage and single stage rocket concepts. Difference and benefits of bell thrusters and aerospikes.

Week 6: A brief dive into orbital mechanics, orbital transfer manoeuvres and payload deployment. This will be used to further look into planetary fly-bys, gravitational turn trajectories, and interplanetary trajectories.

Week 7: Learn about re-entry dynamics. plotting re-entry trajectories(topics like polynomial descent gradient), the physics and maths that go behind re-entries.

Week 8: Analysis of the Voyager missions and their trajectories that have taken them to interstellar space. Analysis of SpaceX's booster landings for more recent developments and to gain better understanding.

Sources:
Main Reference Source: William E. Wiesel, 'Spaceflight Dynamics', 2nd Ed., McGraw-Hill Additional Material: Francis J.Hale, 'Introduction to Space Flight', Prentice Hall, 1994. Apart from that Google and Youtube are always an open option to understand and look up more detail.