INTRODUCTION TO LAUNCH VEHICLE ANALYSIS AND DESIGN

PROF. ASHOK JOSHI
Department of Aerospace Engineering
IIT Bombay

PRE-REQUISITES : No specific pre-requisites are necessary. However, basic understanding of rigid body mechanics, fluid mechanics, and thermodynamics is desirable.

INTENDED AUDIENCE : Undergraduate / postgraduate students, participants from industries involved with tasks related to space agencies, personnel from defence establishments engaged with missile system configuration design, teachers of engineering colleges having aerospace as the discipline

COURSE OUTLINE :

Space has always been of keen interest to mankind as it is believed to contain information relevant to formation, existence and continued sustenance of our planet. Space mission is defined as an act of transporting a space object to its designated spot and then carrying out the scientific / technological activities. Transportation of these objects is done through launch vehicles which are important elements of any space mission. Launch vehicles provide the space object with sufficient energy to enable it to set us a desired space mission. The course aims to introduce fundamental principles governing ascent mission trajectory design including the configuration design of launch vehicles. It also aims to present various techniques that help in synthesizing the trajectory and the launch vehicle for specified objectives.

ABOUT INSTRUCTOR :

Prof. Ashok Joshi is a professor of Aerospace Engineering at the Indian Institute Technology, Bombay in the broad area of Dynamics and Control of Flexible Flight Vehicles. He has over thirty-five years of teaching and research experience in the broad areas of Modelling, Dynamics, Navigation, Control and Guidance of Flexible Flight Vehicles. His research interests include; Flight Vehicle Navigation & Guidance, Structure-Control Interaction, Unmanned Aerial Systems, Multi-agent swarming algorithms, collaborative and cooperative missions. He has published 41 papers in journals and 74 in conference proceedings. He has taught the spaceflight mechanics to both undergraduate and postgraduate students for more than fifteen years.

COURSE PLAN :

Week 1: Introduction, Course Plan, Ascent Mission Basics, Force and Geometry Models 1 & 2

Week 2: Idealized Performance, Trajectory Under Gravity, Impact of Gravity, Impact of Drag

Week 3: Curvilinear Motion Concept, Constant Pitch Rate Solution, Constant Velocity Solution, Constant (T/m) solution

Week 4: Ascent Mission Design, Multi-stage Rocket Concept, Multi-stage Design Basics, Multi-stage Formulation

Week 5: Optimal Staging Concept, Lagrange's Solution, Approximate Staging Solution, Concept of Rocket Variant

Week 6: Variant Design Solution, Parallel Staging Concept, Relativistic and SSTO Rocket Concepts, Air-breathing Rockets and Ballistic Missiles

Week 7: Jet Damping and Spin in Rockets and Missiles, Basics of Rocket Launching, Fundamentals of Re-entry, Typical Re-entry Techniques

Week 8: Revision of the Material and Doubt Clearing by Tas, Instructor