AS107: *Science of Rockets (12 lectures in 18 hrs)*
(A certificate course for high school, UG, PG and PG+ students)
***Instructors:** S. Palit*
***Teaching assistants**: S. Chakraborty, S. Biswas, K. Belwal, M. Bisht*
***Mode of Instruction**: English*

Syllabus

***Introduction*(1 Lecture)**
Instructor: S. Palit

Overview of Rocket Science; History and evolution of rocketry; Applications of rockets; BasicPrinciples - Newton's laws of motion, conservation of momentum; Components of a rocket.

***Fundamentals of Rocket Propulsion and Propellants* (2 Lectures)**
Instructor: S. Palit

Principles of Rocket Propulsion; Thrust and specific impulse; Rocket equations (Tsiolkovsky's equation); Types of Rocket Propulsion Systems - chemical propulsion, electric propulsion, nuclear propulsion; Types of Propellants (chemical) - solid propellants, liquid propellants (bipropellants and monopro pellants), hybrid propellants; Propellant Characteristics - energy content, density, specific impulse; Propellant Storage and Handling.

***Rocket Engine and Design* (1 Lecture)**
Instructor: S. Palit

Components of a Rocket Engine - combustion chamber, nozzle, fuel and oxidizer delivery systems; Thermodynamics of Rocket Engines - combustion processes, heat transfer; Performance Parameters – thrust, specific impulse.

***Nozzle Design and Flow Mechanics* (1 Lecture)**
Instructor: S. Palit

Types of Nozzles - converging-diverging nozzles, Bell nozzles, isentropic flow in Nozzles; Area-Mach number relationship; Choked flow; Expansion and Compression Waves.

***Aerodynamics of Rockets* (1 Lecture)**
Instructor: S. Palit

Aerodynamic Forces on Rockets- Lift, drag and stability, Atmospheric Flight - Subsonic, transonic, and supersonic flight - Mach number regimes, Design Considerations - Nose cone design - Fins and stabilization

***Rocket Flight Dynamics* (1 Lecture)**
Instructor: S. Palit

Phases of Rocket Flight – Launch – Ascent - Orbit insertion, Equations of Motion - Gravity turn - Thrust vectoring, Trajectory Analysis - Vertical and horizontal flight

***Orbital Mechanics* (1 Lecture)**
Instructor: S. Palit

Basics of Orbital Mechanics; Kepler's laws of planetary motion; Types of orbits (LEO, MEO, GEO, HEO); Orbital Maneuvers; Hohmann transfer - Bi-elliptic transfer; Plane changes; Gravity Assist and Slingshot Maneuvers.

***Satellite and Payload Considerations* (1 Lecture)**
Instructor: S. Palit

Satellite Design; Structure; Power systems; Communication systems; Payload Integration; Payload fairing; Vibration and shock considerations; Launch and Deployment.

***Advanced Propulsion Systems* (1 Lecture)**
Instructor: S. Palit