ROCKET PROPULSION

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TYPE OF COURSE: New | Elective | UG/PG
COURSE DURATION: 12 weeks (27 Jan’ 20 - 17 Apr’ 20)
EXAM DATE: 25 Apr 2020

PRE-REQUISITES: Nil
INTENDED AUDIENCE: Engineering students and practicing engineers
INDUSTRIES APPLICABLE TO: DRDO, ISRO, HAL, Space and Defense-related industries

COURSE OUTLINE:
The fundamental aspects of rockets and the current trends in rocket propulsion are dealt with in this course. Starting with description of motion in space, the requirements of rockets for placing space-crafts in different orbits and escaping the gravitational fields of the planets are examined.

ABOUT INSTRUCTOR:
Prof. K. Ramamurthi worked in ISRO and thereafter in the Department of Mechanical Engineering at IIT Madras. He is presently Chairman of the Combustion and Shock Wave Panel (CDSW) of ARMREB in DRDO and Chairman of Extramural Research in Combustion of SERB.

Prof. S Varunkumar is currently working as an Assistant Professor in the Department of Mechanical Engineering at IIT Madras. He teaches undergraduate thermodynamics and graduate level course in numerical methods for thermal engineering, combustion and rocket propulsion.

COURSE PLAN:
Week 1: Motion in Space, Rotational Frame of Reference and Orbital Velocities
Week 2: Velocity Requirements, Theory of Rockets, Theory of rocket propulsion, Rocket Equation and Staging of Rockets
Week 3: Review of Rocket Principles: Propulsion Efficiency, Nozzles, Theory of Nozzles
Week 4: Nozzle Shape, Area Ratio of Nozzles, Characteristic Velocity and Thrust Coefficient
Week 5: Divergence Loss in Conical Nozzles and the Bell Nozzles, Unconventional Nozzles and Problems in Nozzles, Propellants, Criterion for Choice of Chemical Propellants
Week 7: Low energy liquid propellants and Hybrid propellants, Solid Propellant Rockets
Week 8: Design Aspects of Solid Propellant Rockets.
Week 9: Review of Solid Propellant Rockets, Liquid Propellant Rockets
Week 10: Analysis of Gas Generator and Staged combustion cycles and Introduction to Injectors, Cooling of Chambers and Mixture Ratio Distribution Efficiencies due to mixture ratio distribution and incomplete vaporization.
Week 11: Pumps and Turbines: Propellant Feed System at Zero “g” Conditions, Review of Liquid Bi-propellant Rockets and Introduction to Mono-propellant Rockets, Hybrid Rockets.
Week 12: Electrical, Nuclear Rockets and Advanced Propulsion, Principles of Electrostatic and Electromagnetic Rockets, Electrical Thrusters, Electrical and Nuclear Rockets; Advanced Propulsion.