INTRODUCTION TO AIRBREATHING PROPULSION

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PRE-REQUISITES : Fluid Mechanics, Thermodynamics, Basic Compressible flows

INTENDED AUDIENCE : Junior/Senior undergraduate students and postgraduate students of Aerospace, and Mechanical Engineering

INDUSTRIES APPLICABLE TO : Aerospace, Mechanical, Power Generation and Defense Industries

COURSE OUTLINE :
Due to the rapid advance in air transportation as well as military and intelligence missions, aircraft and rocket propulsion has become an essential part of engineering education. Propulsion is the combined aero-thermal science for aircrafts and rockets. Propulsion has both macro and microscales. Macroscale handles the performance and operation of aircrafts and rockets during different missions, while microscale is concerned with component design including both rotary modules (i.e., compressor, fan, pump, and turbine) and stationary modules (i.e., intake, combustor, afterburner, and nozzle). The fundamental knowledge of propulsion is expected to improve the design of the industrial propulsive systems by enhancing the stability, improving the efficiency, and reduction in pollutant formation. In this course, an integrated understanding of theory and practice of propulsion would be covered. The discussion would continue on the design, operation, installation and several inspections, repair, and maintenance aspects of aircraft and rocket engines.

ABOUT INSTRUCTOR :
Prof. Ashoke De is currently working as Associate Professor in the Department of Aerospace Engineering at Indian Institute of Technology Kanpur. He leads large scale initiatives in the modeling of turbulent reacting and non-reacting flows at IIT Kanpur. So far, he has authored more than 130 peer reviewed articles in journals and conferences. His primary research focus is the emerging field of computational mechanics with particular interest in combustion and turbulent flows.

COURSE PLAN :

Week 1: Introduction to Propulsion, Review of basic fluid mechanics and thermodynamics

Week 2: Introduction to compressible flows: 1D steady, isentropic flows, Normal shocks

Week 3: Introduction to gas turbine engines: Thrust, efficiencies and performance parameters

Week 4: Piston Engines and Propellers

Week 5: Performance/cycle analysis: Pulsejet, Ramjet, and Scramjet Engines

Week 6: Performance/cycle analysis: Turbojet, Turbofan, Turboramjet

Week 7: Performance/cycle analysis: Turboprop, Turboshaft, and Propfan

Week 8: Combustors & after burners, intakes, nozzles

Week 9: Industrial Gas Turbines, Introduction to turbo-machinery: basic principles and equations

Week 10: Centrifugal compressor: Principle, performance characteristics, efficiency, stall and surge

Week 11: Axial compressor: Theory, single stage and multi-stage compressor, cascades and losses

Week 12: Axial turbines: Theory of operation, stage and overall performances, turbine and compressor matching, turbine blade cooling; Radial Flow Turbine, Module Matching