Propulsion Systems, Lecture 1

Introduction

Classifications of propulsion systems:

1) Airbreathing: reciprocating, turbojet, turbofan, turboprop, turboshaft, ramjet, scramjet, pulsejet, pulse detonation engine
2) Non-airbreathing: chemical rockets (gas, liquid, solid, hybrid), electric, nuclear, solar, laser, biological

Overall goal of these systems:

1) Take mass from surroundings and throw it backwards
   a. Take $\dot{m}$ at V_0 (flight speed) and throw it out at $V_0 + \Delta V$
2) Take mass onboard vehicle and throw it backwards

Physical concepts of importance used to understand propulsion systems

1) Newtonian mechanics (e.g., thrust, rotating machinery)
2) Fluid mechanics: aerodynamics (e.g., blades), gas dynamics (e.g., inlets/nozzles, compressors/turbines)
3) Thermodynamics (e.g., cycle analysis, liquid phase change)
4) Heat transfer (e.g., turbine blades, rocket nozzle)
5) Chemistry (e.g., combustor)

Note on units and dimensions:

1) In this class all problems will be solved/given in SI units.
2) However, the text provides derivations/formulas for either SI or English.
3) $\sum \vec{F} = \frac{d(m\vec{V})}{dt}$ works fine in SI: N = (kg*m/s)/s
4) However, in English there is a problem: lbf = (lbm*ft/s)/s
5) Must include conversion from lbm to lbf, g_C = 32.174 ft*lbm/(lbf*s^2): $\sum \vec{F} = \frac{1}{g_c}\frac{d(m\vec{V})}{dt}$
6) Don't get confused when you see g_c in book. In SI g_c = 1.