ME 323: FLUID MECHANICS-II

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Lecture-11

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Blow Down Process

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Problem

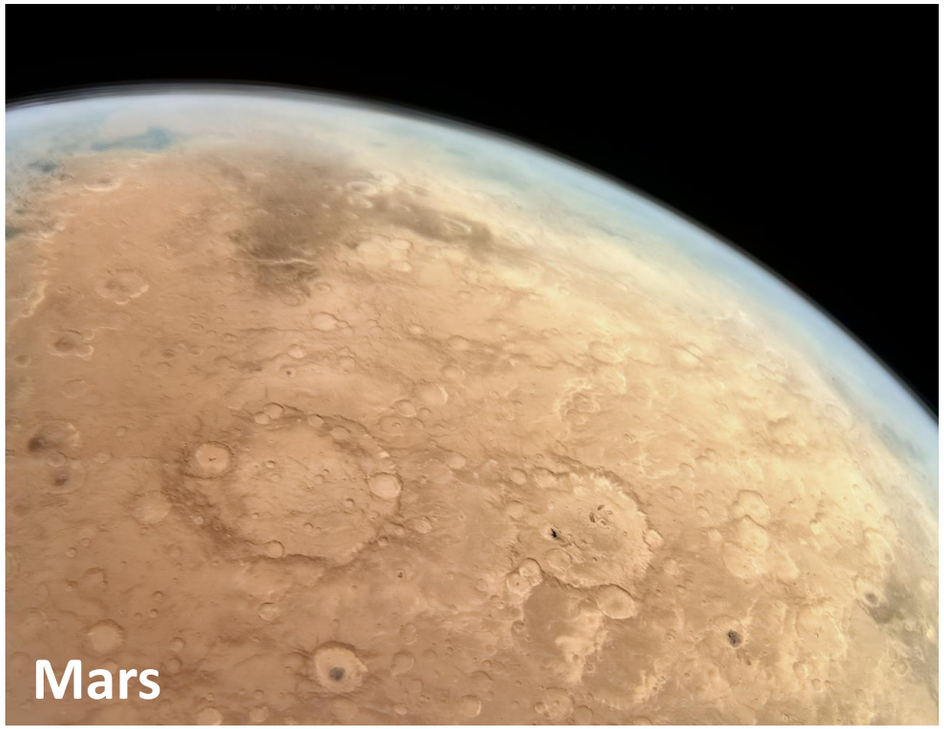
An air tank of volume 1.5 m^3 is at 800 kPa and 20^oC when it begins exhausting through a converging nozzle to sea-level condition p = 100 kPa. The throat area is 0.75 cm^2. Estimate:

1) Initial mass flow rate
2) Time to blowdown to 500 kPa and mass flow rate at this condition
3) Time when the nozzle ceases being choked and mass flow rate at this conditions
4) Graphically show the unsteady process until the nozzle is choked.

$$t \approx 1.75 \frac{V}{a_0 A_e} ln\left[\frac{p_{0,0}}{p_{0,t}}\right]$$

Fluid dynamics to explore ... ...

Beyond the earth, toward Mars



The atmosphere of Mars is the layer of gases surrounding Mars. It is primarily composed of **Carbon dioxide (95%)**, nitrogen (2.85%), and argon (2%). It also contains trace levels of water vapor, oxygen, carbon monoxide, hydrogen, and noble gases.

TABLE I. Characteristics of Martian and Earth's atmospheric environment.

Features	Mars	Earth
Acceleration of gravity (m/s^2)	3.72	9.78
Atmospheric pressure (Pa)	640	101 300
Air density (kg/m^3)	0.0167	1.22
Mean temperature (°C)	−63	15
Sound velocity (m/s)	227	340
Atmospheric dynamic viscosity [kg/(m s)]	1.289×10^{-5}	1.789×10^{-5}
Atmospheric constants (J/kg/K)	188	287
Specific heat capacity ratio(γ)	1.29	1.40
Molar mass (g/mol)	44.01	28.96

Challenges in designing air vehicle in Mars:

- Low Re
- Compressibility, rarefaction
- C_L, C_D ???