SNS College of Technology

(An Autonomous Institution)

19ASB202/ Aero Engineering Thermodynamics

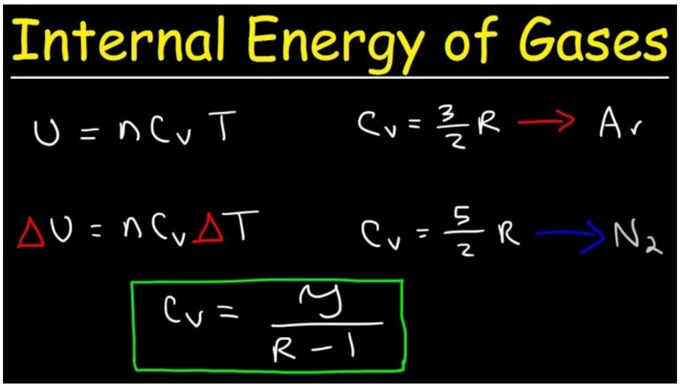
Unit -4/ GAS MIXTURES

DIFFERENCE AND RATIO OF HEAT CAPACITIES

In thermal physics and thermodynamics, the heat capacity ratio, also known as the adiabatic index, the ratio of specific heats, or Laplace's coefficient, is the ratio of the heat capacity at constant pressure (CP) to heat capacity at constant volume (CV). It is sometimes also known as the isentropic expansion factor and is denoted by γ (gamma) for an ideal gas[note 1] or κ (kappa), the isentropic exponent for a real gas. The symbol gamma is used by aerospace and chemical engineers.

he heat capacity ratio is important for its applications in thermodynamical reversible processes, especially involving ideal gases; the speed of sound depends on that factor.

To understand this relation, consider the following thought experiment. A closed pneumatic cylinder contains air. The piston is locked. The pressure inside is equal to atmospheric pressure. This cylinder is heated to a certain target temperature. Since the piston cannot move, the volume is constant. The temperature and pressure will rise. When the target temperature is reached, the heating is stopped. The amount of energy added equals CVΔT, with ΔT representing the change in temperature.



$$\varepsilon = \frac{\Delta T_{min.capacity\ rate\ fluid}}{\Delta T_i} = \frac{\Delta T_{min.capacity\ rate\ fluid}}{T_{h,i} - T_{c,i}}$$

where, $\Delta T_{\text{min. Capacity rate fluid}}$ = temperature difference of the fluid which has minimum capacity rate.

Heat Capacity Rate Ratio (C_r) :

$$C_r = \frac{C_{min}}{C_{max}} = \frac{\left(\dot{m}\, c_p\right)_{min}}{\left(\dot{m}\, c_p\right)_{max}}$$

C_r is a dimensionless number

$$0 \le C_r \le 1$$

$$C_r = 0 \quad when \quad c_p \to \infty \quad (case\ of\ evaporation\ or\ condensation)$$

$$C_r = 1\ when\ C_{min} = C_{max}\ (case\ of\ equal\ capacity\ rates)$$