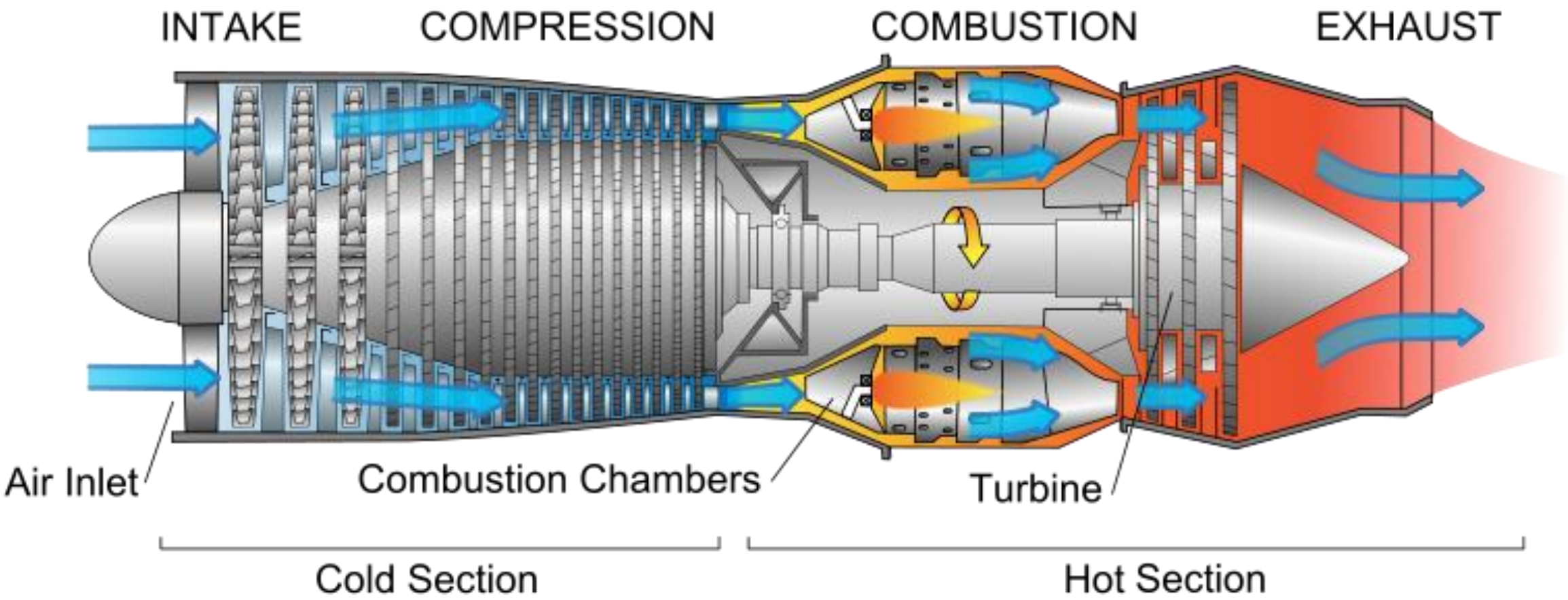
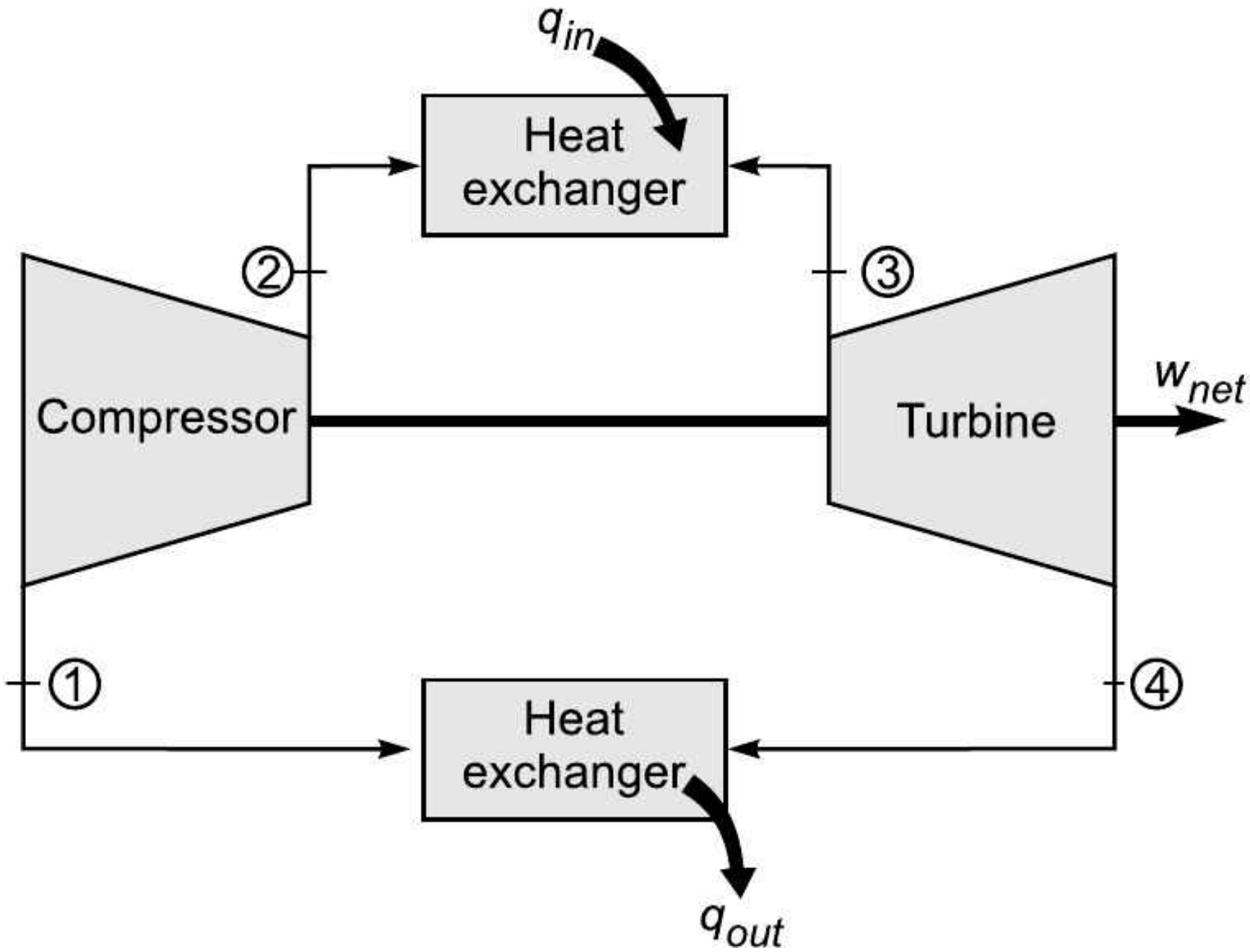
॥ नमस्ते ॥

BRAYTON CYCLE

What is Brayton cycle?

- The Brayton cycle was proposed by George Brayton in 1870 for use in reciprocating engines.
- Modern day gas turbines operate on Brayton cycle and work with rotating machinery.
- Gas turbines operate in open-cycle mode, but can be modelled as closed cycle using air standard assumptions.
- Combustion and exhaust replaced by constant pressure heat addition and rejection.
- It is also called joules cycle or constant pressure cycle

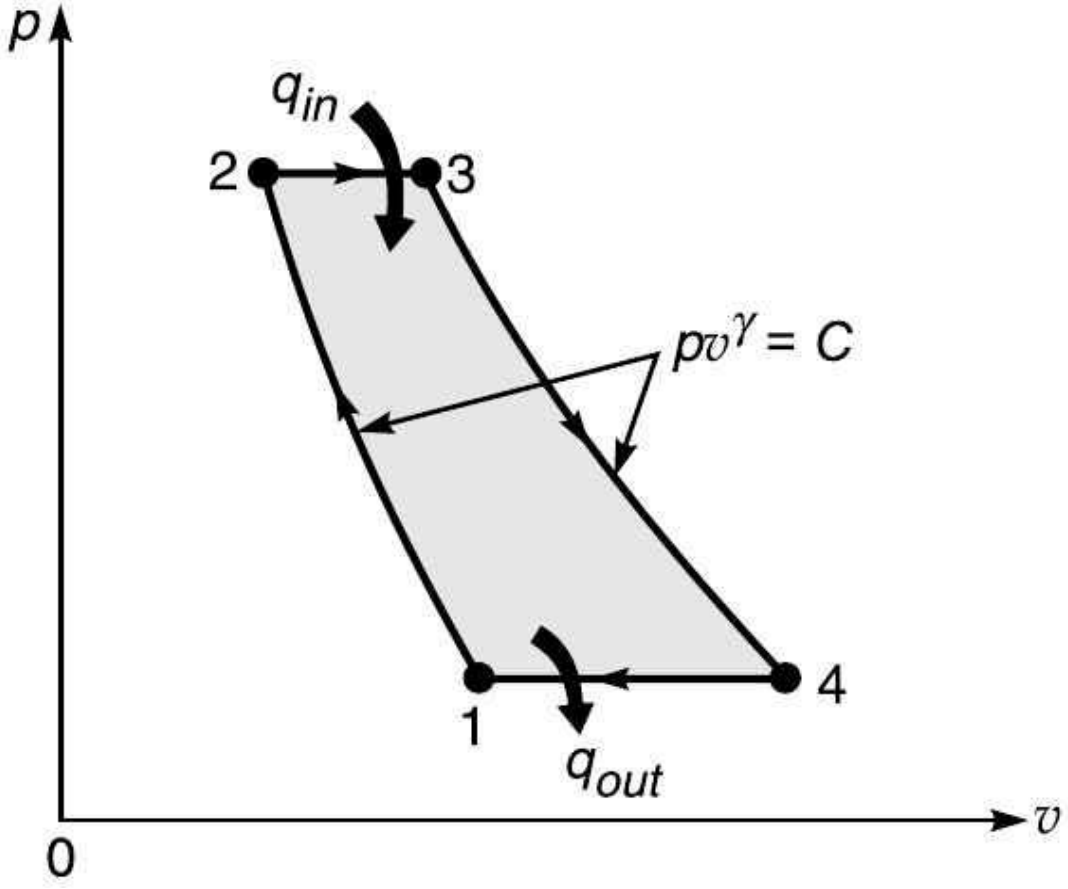

INTAKE
COMPRESSION
COMBUSTION
EXHAUST
Air Inlet
Combustion Chambers
Turbine
Cold Section
Hot Section

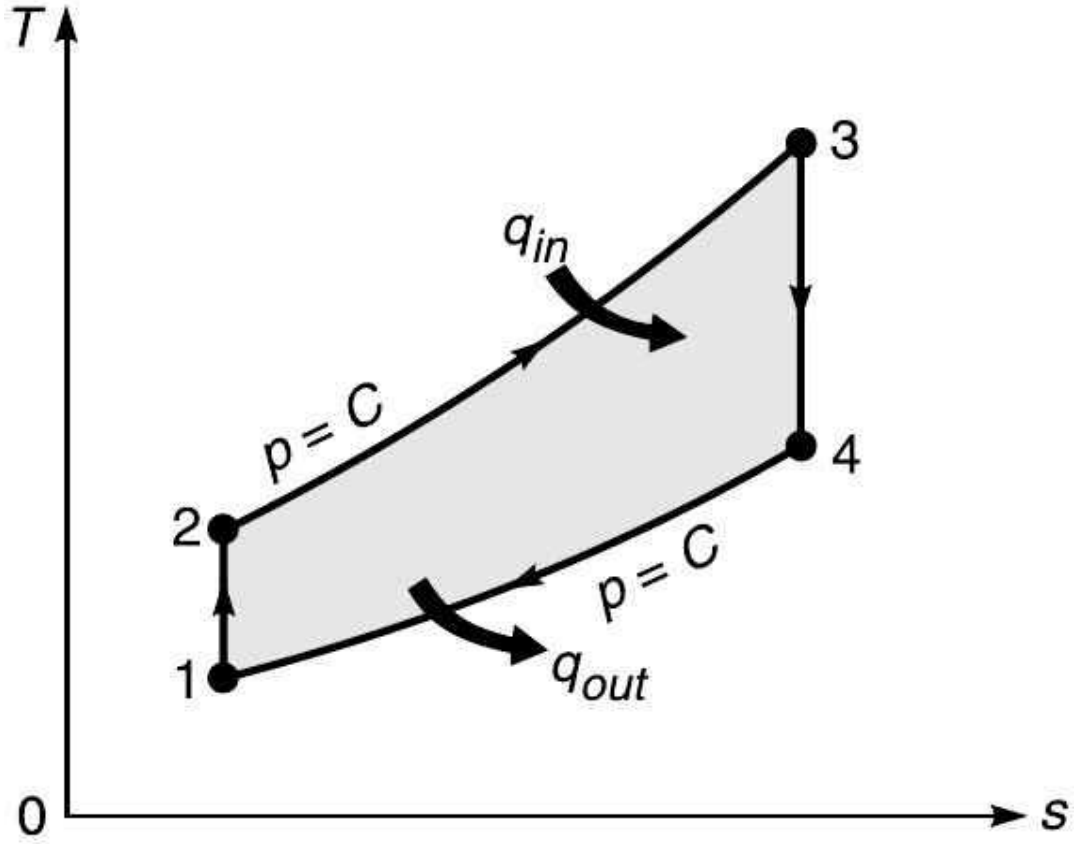

q_{in}
Heat exchanger
②
③
Compressor
Turbine
w_{net}
①
④
Heat exchanger
q_{out}

The Brayton cycle consists of four internally reversible processes:

- **1-2 Isentropic compression (in a compressor)**
- **2-3 Constant-pressure heat addition**
- **3-4 Isentropic expansion (in a turbine)**
- **4-1 Constant-pressure heat rejection**

Brayton Cycle P-V & T-S Diagram





Efficiency of the Brayton cycle

- $Q = W + U$

- Enthalpy is the measurement of energy in a thermodynamic system. The quantity of enthalpy equals to the total content of heat of a system, equivalent to the system's internal energy plus the product of volume and pressure.
- Enthalpy h is total heat of the substance
- $h = u + pv$
- & work
- $W = pdv$
- So Q $= \Delta u + pdv$
- $\Delta u = Q - pdv$
- $u_2 - u_1 = Q - \mathrm{p}(V_2 - V_1)$

- $u_2 - u_1 = Q - \mathrm{p}(V_2 - V_1)$
- $u_2 - u_1 = Q - pV_2 - pV_1)$
- $(u_2 - pV_2)$-$(u_1 - pV_1)$= Q
- $h_2 - h_1 = Q$
- $h_2 - h_1 = (T_2 - T_1)cp = Q$
- Now efficiency is
- Efficiency =$\eta = \frac{Work\ Output}{heat\ Input}$=$\frac{Q\ in - Qout}{Q\ in}$= 1 - $\frac{Q_{out}}{Q_{in}}$
- $\eta = 1 - \frac{cp_{(T_4 - T_1)}}{cp_{(T_3 - T_2)}}$
- $\eta = 1 - \frac{T_1\left({}^{T_4}/_{T_1} - 1\right)}{T_2\left({}^{T_3}/_{T_2} - 1\right)} =$

- For Isentropic Process
- $\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\gamma-1/\gamma} = \left(r_p\right)^{\gamma-1/\gamma}$
- $\frac{T_3}{T_4} = \left(\frac{P_3}{P_4}\right)^{\gamma-1/\gamma} = \left(r_p\right)^{\gamma-1/\gamma}$
- Since we get $p_2 = p_3$ and $p_4 = p_1$ we get
- $\frac{T_2}{T_1} = \frac{T_3}{T_4}$ or $\frac{T_4}{T_1} = \frac{T_3}{T_2}$
- $\eta = 1 - \frac{1}{r_p^{(\gamma-1)/\gamma}}$
- Where r_p $is\ pressure\ ratio$ $\frac{p_2}{p_1}$

Today's Amazing Fact!!

Finger prune underwater not because it absorbs water but actually our brain increase the area of the finger so that our grip in the underwater enhanced

धन्यवाद

Prepared By
Mr.Pankaj Salunkhe
(M.Tech Design , B-Tech Aerospace, DME)