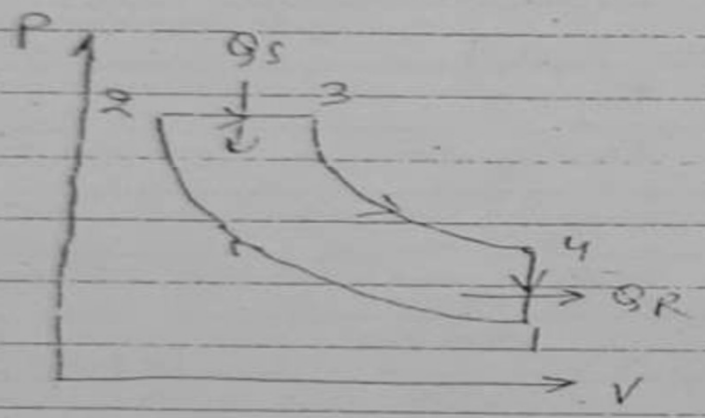
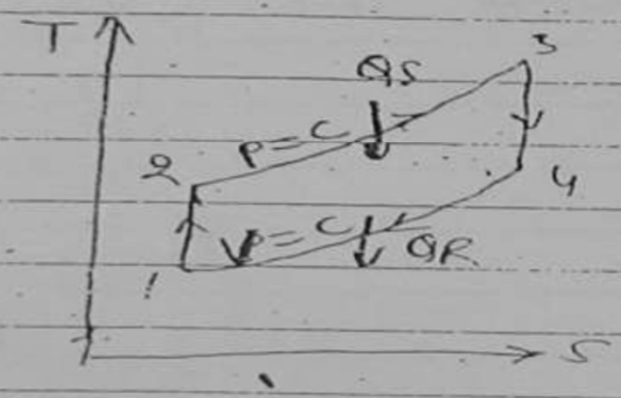
Diesel Cycle

(or) (Const. pressure cycle)





Cut-off Ratio (r_c)

It is the ratio of volume after heat addition to the volume before heat addition.

$$r_c = \frac{V_3}{V_2}$$

Air standard effⁿ. of Diesel Cycle :- η_{diese}

$$\eta = 1 - \frac{Q_R}{Q_S}$$ 23

$$Q_S = mC_p(T_3 - T_2)$$

$$Q_R = mC_v(T_4 - T_1)$$

$$\eta = 1 - \frac{\cancel{m}C_v(T_4 - T_1)}{\cancel{m}C_p(T_3 - T_2)}$$

$$\eta = 1 - \frac{1}{\gamma}\,\frac{T_1\left(\frac{T_4}{T_1} - 1\right)}{T_2\left(\frac{T_3}{T_2} - 1\right)} \quad \text{--- (1)}$$

For 1-2

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1} = \frac{T_2}{T_1} = (r)^{\gamma-1}$$

For 2-3

$$\frac{V_3}{V_2} = \frac{T_3}{T_2} = r_c$$

For 3-4 (adiabatic)

$$T_3 V_3^{\gamma-1} = T_4 V_4^{\gamma-1}$$

$$\frac{T_3}{T_4} = \left(\frac{V_4}{V_3}\right)^{\gamma-1}$$

$$\frac{T_3}{T_4} = \left(\frac{V_1}{V_3}\right)^{\gamma-1}$$

$$\frac{T_3}{T_4} = \left(\frac{V_1}{V_2} \cdot \frac{V_2}{V_3}\right)^{\gamma-1}$$

$$\frac{T_3}{T_4} = \left(r \cdot \frac{1}{r_c}\right)^{\gamma-1} \qquad (24)$$

$$\frac{T_3}{T_4} = \left(\frac{r}{r_c}\right)^{\gamma-1}$$

$$\frac{T_3}{T_4} = \frac{r^{\gamma-1}}{r_c^{\gamma-1}}$$

$$\frac{T_3}{T_4} = \frac{T_2/T_1}{r_c^{\gamma-1}} \qquad \therefore \frac{T_2}{T_1} = r^{\gamma-1}$$

$$\frac{T_3}{T_4} = \frac{T_2}{T_1} \cdot \frac{1}{r_c^{\gamma-1}}$$

$$\frac{T_3}{T_4} = \frac{T_3}{T_2} \cdot r_c^{\gamma-1}$$

$$\frac{T_4}{T_1} = r_c^{1} \cdot r_c^{\gamma-1} = r_c^{\gamma}$$

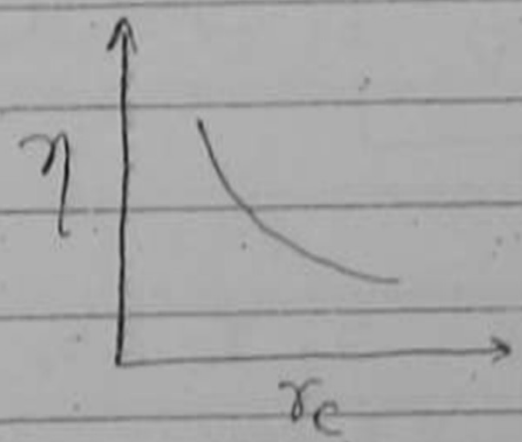
from eqn. (i)

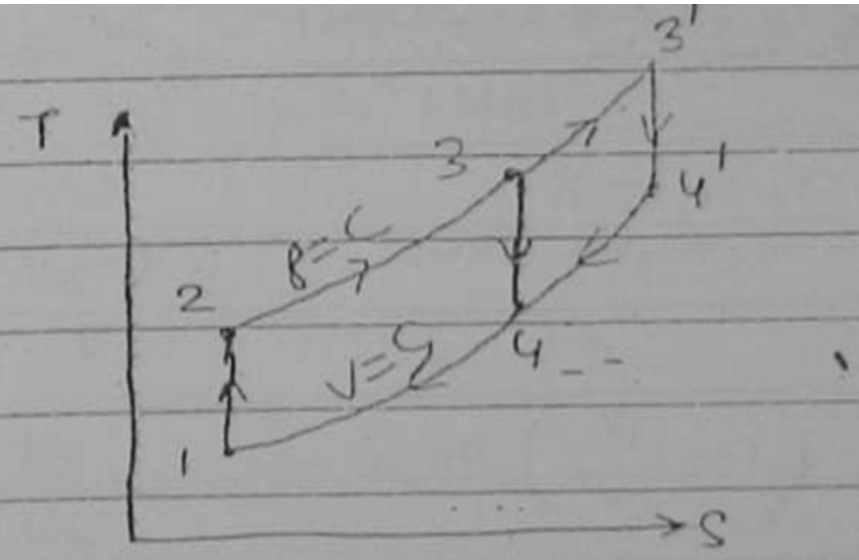
$$\boxed{\eta = 1 - \frac{1}{\gamma} \cdot \frac{1}{(r)^{\gamma-1}} \left[\frac{r_c^{\gamma}-1}{r_c-1}\right]}$$

The eff. of diesel cycle depends on
Compression ratio (r)
Cut-off ratio (r_c) and
Adiabatic index (γ)

25

As the cut-off ratio increases the
eff^n. of diesel cycle decreases.





With increasing in cut-off ratio the heat rejection also increases because heat rejection is occuring at const. volume and the slope of const. volum lines is more than the slope of const. pressure lines.

Expansion ratio (r_e)

It is defined as the ratio of volume after expansion (V_4) to the volume before expansion (V_3)

$$\boxed{r_e = \frac{V_4}{V_3}}$$

26

Relationship b/w r, r_c & r_e

$$r_c r_e = \frac{V_3}{V_2} \times \frac{V_4}{V_3} = \frac{V_4}{V_2} = \frac{V_1}{V_2}$$

$$\boxed{r_c r_e = r}$$