Page No.
Date

Section-4

Q1

Ans. Solution :-

$P_1 = 10$ bar

$P_3 = 0.75$ bar

Ethalpy at inlet to cylinder,

At 10 bar, 200°C

$h_1 = 2875.3$ KJ/kg

At 0.75 Bar, $h_f = 384.39$ KJ/kg

Heat added per kg of steam.

$$q_{add} = h_1 - h_{f \text{ at } 0.75 \text{ bar}}$$

$$q_{add} = 2490.91 \text{ KJ/kg}$$

Expansion ratio, $r = \frac{1}{0.25} = 4$

$w_e = 77.77$ KJ/kg

- Total work per kg of steam $= w_{ne} + w_e$

$= 235.36$ KJ/Kg

- Fraction of work obtained by expansive working $= \frac{w_e}{w_{ne} + w_e} = \frac{77.77}{235.36} = 0.3304$

$\Rightarrow 33.04\%$

Page No.
Date

- Thermal efficiency of cycle $= \frac{235.36}{q_{add}}$

$= \frac{235.36}{2159.12} = 0.1090$

or 10.90%.

Ans Fraction of expansive work = 33.04% of total output
thermal efficiency = 10.90%.

- For cycle having complete non expansive work. Such modified cycle is shown by 1'-3-4-5.
- This refers to the situation when cut-off shall become unity.
- Therefore, the mass of steam admitted shall be inc.(ases) as compared to previous case. In which 1 kg steam is admitted upto 60% cutoff point.
- Steam admitted per cycle when cut off is at 60% = 1 kg.
- Steam admitted per cycle when cut off becomes unity $= \frac{1}{0.6} = 1.66$ kg

Page No.
Date

- Total work per cycle = Area 1'-3-4-5

$$= (p_1 - p_3) \cdot v_4 \times 1.66$$
$$= 261.59 \text{ kJ}$$

$$\% \text{ inc. in work} = \left(\frac{261.59 - 235.36}{235.36}\right) \times 100$$
$$= 11.14\%$$

- Modified thermal effi. $= \frac{261.59}{1.66 \times 2159.12}$
$$= 0.0729 \quad 7.29\%$$

- Here % reduction in thermal eff. % dec(tes) in eff.

$$= \left(\frac{10.9 - 7.29}{10.9}\right) \times 100$$
$$= 33.12\%$$

Ans % Inc(tes) in work = 11.14 %

% dec(tes) in eff. = 33.12 %

Ans