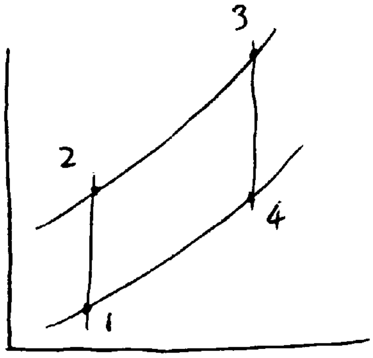
GAS TURBINES

Qu.1



$T_3 = 1000^\circ C = 1273\ K$

$r_p = 8$

$T_1 = 15^\circ C = 288\ K$

$$\frac{w}{c_p T_1} = \frac{T_3}{T_1}\left(1 - r_p^{\frac{1-\gamma}{\gamma}}\right) - \left(r_p^{\frac{\gamma-1}{\gamma}} - 1\right)$$

$$\therefore \quad w = c_p\left[T_3\left(1 - r_p^{\frac{1-\gamma}{\gamma}}\right) - T_1\left(r_p^{\frac{\gamma-1}{\gamma}} - 1\right)\right]$$

$$= 1010\left[1273\left(1 - 8^{\frac{1-1.4}{1.4}}\right) - 288\left(8^{\frac{1.4-1}{1.4}} - 1\right)\right]$$

$$= 339916 \ \ J/kg$$

$$\dot{W} = \dot{m} w$$

$\therefore 10^6 = \dot{m} \times 339916 \quad \therefore$ $\underline{\dot{m} = 2.942}$ kg/s

$$\eta_{th} = 1 - \frac{1}{r_p^{\frac{\gamma-1}{\gamma}}}$$

$$= 1 - \frac{1}{8^{\frac{1.4-1}{1.4}}}$$

$$= 0.448$$

$$\frac{\dot{W}}{\dot{Q}_{in}} = 0.448$$

$$\therefore \dot{Q}_{in} = \frac{10^6}{0.448} = 2.232 \times 10^6 \ \ J/s$$

or $\underline{2.232\ MW}$ heat input