GATE Aerospace Engineering

Assignment – Thermodynamic Jet Cycle

Question 1:- Compute the indicated mean effective pressure and efficiency of a Joule cycle if the temperature at the end of combustion is 2000 K and the temperature and pressure before compression is 350 K and 1 bar. The pressure ratio is 1:3. Assume C_p = 1.005 kJ/kg.K. [C_p = C_{pg}]

Ans:- mean effective pressure = 0.2622 bar, efficiency = 7.22%

Question 2:- Calculate the improvement in the efficiency when a heat exchanger is added to the simple cycle given in the above problem. Why there is an increase in efficiency?

Ans:- efficiency = 81% , increment is around 11 times.

Question 3:- A gas turbine operates on a pressure ratio of 6. The inlet air temperature to the compressor is 300 K and the air entering the turbine is at a temperature of 577 °C. If the volume rate of air entering the compressor is 240 m^3/s. Calculate the net power output of the cycle in MW. Also compute its efficiency. Assume that the cycle operates under ideal conditions.

Ans:- power output 39.207MW, efficiency = 40%

Question 4:- In a gas turbine the pressure ratio to which air at 15 °C is compressed is 6. The same air is then heated to a maximum permissible temperature of 750 °C. First in a heat exchanger and then combustion chamber. It is then expanded in two stages that the expansion work is minimum. The air is reheated to 750 °C after the first stage. Determine the cycle thermal efficiency, the work ratio (W_N/W_T) and net shaft work per kg of air.

Ans:- Thermal efficiency = 58.33%, work ratio = 0.583, shaft work = 270.88 kJ/kg

Question 5:- A gas turbine plant operates between 5 °C and 839 °C. Find

(i) Pressure ratio at which cycle efficiency equals Carnot cycle efficiency
(ii) Pressure ratio at which maximum work is obtained
(iii) Efficiency under conditions giving maximum work.

Ans:- (i) 128, (ii) 11.31, (iii) 50%

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