

Rajiv Gandhi institute of Petroleum Technology

Final Exam(part-B)

Sub: Engg. Thermodynamics

Sem-1

31.08.2021 (1hour)

B.Tech : all branches

24 Marks

Answer all questions

Q1: Steam enters a converging-diverging nozzle operating at steady state with $P_1=40$ bar, $T_1=400^\circ\text{C}$ and a velocity of 10m/s . The steam flows through the nozzle with negligible heat transfer and no significant change in potential energy. At the exit, $P_2=15\text{bar}$ and the velocity is 665m/s . the mass flow rate is 2kg/s . determine the exit area of the nozzle in m^2 . (5M)

Q2: An unknown gas passes through an adiabatic nozzle. It enters at a pressure of 5 bar, temperature of 673K and leaves at a pressure of 1bar . The process is steady state and reversible. Find the exit temperature of the gas if C_p of the gas is 40 J/mol.K and follows the below equation of state: (7M)

$$V = (RT/P) + aTP \quad \text{and} \quad a = 1 \text{ cm}^3/\text{mol.bar.K}$$

Q3: Rankine cycle is used to operate a heat engine. In this engine, a saturated steam leaves the boiler at temperature 623K ; the operating temperature of condenser is 373K . turbine efficiency is given as 80% . (12)

- (i) What is the quality of working fluid leaving the turbine
- (ii) Determine the overall efficiency of the heat engine
- (iii) In the cycle, to increase the steam temperature to 723K at constant pressure, a superheater is introduced right after the boiler by keeping all the other specifications unchanged. Determine the quality of the working fluid leaving the turbine and the overall efficiency of the cycle.