

# Rajiv Gandhi institute of Petroleum Technology

Final Exam(part-A)

Sub: Engg. Thermodynamics

Sem-1

31.08.2021 (1hour)

B.Tech : all branches

24 Marks

---

Answer all questions

Q1: (4+6)

- (i) Write the Van der Waals cubic equation of state. The critical conditions for water is given as  $T_C = 374^\circ\text{C}$ ;  $P_C = 221 \times 10^5 \text{ Pa}$ ; Explaining the derivation steps, Find the values of Van der Waals parameters for water
- (ii) Find the molar volumes of liquid and vapour of ammonia at 19.5bar and  $48^\circ\text{C}$ , If ammonia obeys Van der Waals equation of state. Use the constants  $a \times 10^3 = 422.546 \text{ Pa(m}^3/\text{mol)}^2$ ;  $b \times 10^6 = 37 \text{ m}^3/\text{mol}$

Q2: Calculate the amount of heat which enters or leaves (6M)

1kg of steam initially at 0.5MPa and  $250^\circ\text{C}$ , when it undergoes the following processes

- a. It is confined by a piston in a cylinder and is compressed to 1MPa and  $300^\circ\text{C}$  as the piston does 200kJ of work on the steam
- b. It passes in steady flow through a device and leaves at 1MPa and  $300^\circ\text{C}$  while, per kg of steam flowing through it, a shaft puts in 200kJ of work. Changes in K.E and P.E are negligible.

Q3: Water heated to a temperature and pressure of  $550^\circ\text{C}$  and  $30 \times 10^5 \text{ Pa}$  enters an adiabatic turbine operated at steady-state. The steam leaving the turbine has a pressure 1atm and temperature of 473K. (4+4M)

- A. Find the entropy generated/lost per kilogram of steam passing through the turbine?
- B. Determine the maximum work (per kilogram of entering steam) attainable from a turbine with this inlet and outlet stream of steam