Dr Antaram Sarve, (87)

22/11/2023 Roll No. .....

**NATIONAL INSTITUTE OF TECHNOLOGY, HAMIRPUR**

B. Tech (Chemical Engineering) –III[rd] Semester

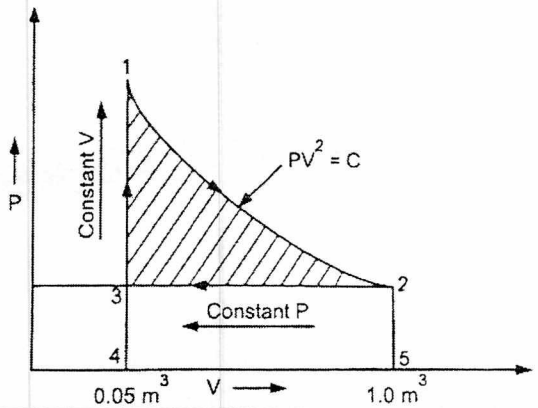
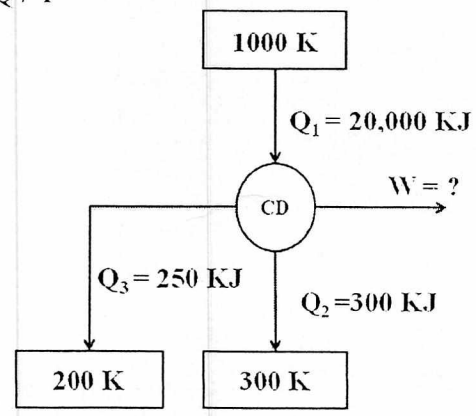
END-SEMESTER EXAMINATION (Nov.-Dec., 2023)

## CH-212 Chemical Engineering Thermodynamics-I

**Duration: 3 Hrs.** **Max. Marks: 50**

Note:

- *Attempt all questions*
- *Wherever necessary, draw neat diagram, assume data if required*
- *Assign proper and correct number for each answer in the answer sheet.*

| Sr. No. | Questions | Marks | COs |
|---|---|---|---|
| 1. | 1 kg of a fluid at a pressure of 20 bar containing in a cylinder is allowed to expand behind a piston according to a law $PV^2$ = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston comes to its original position. Afterwards heat is supplied reversibly with the piston firmly locked in position till the pressure is rises the original pressure (20 bar). For an initial volume of $0.05m^3$, calculate the net work done by the fluid.   | 10 | CO1 CO3 |
| 2. | Using clausius inequality show that the change in entropy in a process is related to the heat interaction as dS is greater than and equal to dQ/T ($dS \geq dQ/T$), where the greater sign refers to an irreversible process and equal sign refers to a reversible process. | 10 | CO1 CO2 |
| 3.A. | Explain the statements of second law of thermodynamics with neat diagram. | 05 | CO2 CO4 |
| 3.B. | Calculate the 1. Work output for the following cyclic device.<br>2. $\oint \delta Q / T$   | 05 | CO2 CO3 |

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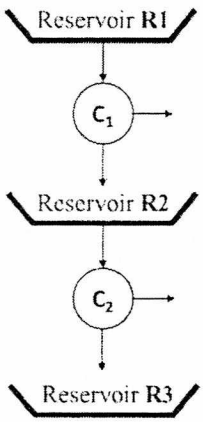
|---|---|---|---|
| **4.A.** | Derive the expression for thermal efficiency of Brayton cycle in terms of temperature and pressure ratio using both the PV and TS diagram. | **05** | CO2<br>CO3 |
| **4.B.** | Calculate power developed in KW/ kg of gas per second and exhaust gas temperature. If the gas turbine supplied with a gas at 1000K and 5 bar to expand adiabatically to 1 bar. The mean specific heat at constant pressure is 1.0425 KJ/kg-K and constant volume is 0.7662 KJ/kg-K. | **05** | CO3<br>CO4 |
| **5.A** | Explain absorption refrigeration system with neat diagram and Derive the expression for coefficient of performance. | **05** | CO3<br>CO4 |
| **5.B.** | Consider the two Carnot engines $\mathbf{C_1}$ and $\mathbf{C_2}$ as shown in figure. If the efficiencies of the engines $\mathbf{C_1}$ and $\mathbf{C_2}$ are 0.6 and 0.5, respectively. If the temperature of the reservoir $\mathbf{R_1}$ is 1000K Calculate the temperature (in K) of reservoir $\mathbf{R_3}$.<br>  <br> | **05** | CO3<br>CO4 |