Rajiv Gandhi Institute of Petroleum Technology
(RGIPT), Jais (U.P.) -229305
(An Institute of National Importance under Ministry of Petroleum and Natural Gas, GoI)
Department of Chemical Engineering and Biochemical Engineering

Engineering Thermodynamics (CH-161)

Mid Semester Question Paper

B. Tech. 1st year (Group-B)

Date of examination: 17th January 2022
Maximum marks: 60
Time: 120 mins

Instructions:

(1) If any solutions is found to be copied from internet source
(2) Attempt all questions.
(3) 'XX' means last two digits of your roll number.
(4) Answer the questions precisely to the point.
(5) If any question or any part of the question if found to be copied from anywhere, directly zero marks will be given out of maximum marks.

Q1. What is the work done on a system undergoing a hypothetical adiabatic, isobaric, and isothermal process? **(2 Marks)**

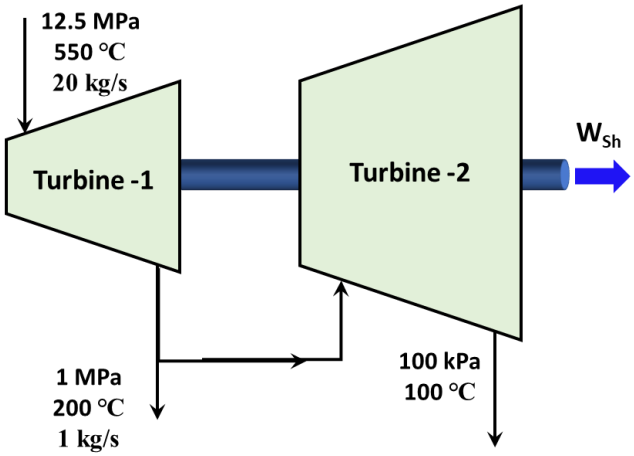
Q2. If we blow air from with our mouth wide open, the air coming out is hot. Whereas if blow air with our mouth partially closed, the air coming out is hot. Why? Explain. **(2 Marks)**

Q3. Arrange the isothermal, isobaric, isochoric, and isentropic processes in the increasing order of the work done in each case. **(2 Marks)**

Q4. Why is a fan required in a automobile engine? **(2 Marks)**

Q5. Is it possible to build an adiabatic constant energy cyclic process? Give explanation. **(3 Marks)**

Q6. A portion of the steam passing through a turbine is removed and fed to another turbine as shown below. Determine the power produced by this turbine. **(3 Marks)**



Q7. Can we plot an irreversible process on the P-v diagram? If yes, explain how using an example. **(4 Marks)**

Q8. Carryout the thermodynamic analysis of a fan being rotating in a vacuum. **(4 Marks)**

Q9. An insulated container contains Nitrogen and Oxygen separated by a removable membrane as shown in the figure below. Both N_2 and O_2 have equal T, P, and n. If the membrane is removed without disturbing the system. Determine the change in the internal energy. **(4 Marks)**

Q10. Two Carnot engines (A and B) operate in series between a high temperature reservoir at 1500 K and a low temperature reservoir at 300 K. Engine A absorbs heat from high temperature reservoir and rejects heat to the engine B. Engine B rejects heat to the low temperature reservoir at 300 K. Both the engines have the same efficiencies. Determine the temperature level at which engine A rejects the heat. If engine A absorbs 1000 kJ of energy as heat form the high temperature reservoir, calculate the work done by engine A and engine B. **(4 Marks)**

Q11. From the following differential pressure equations representing the state of the gas, identify the correct expression and determine the equation of the state. **(5 Marks)**

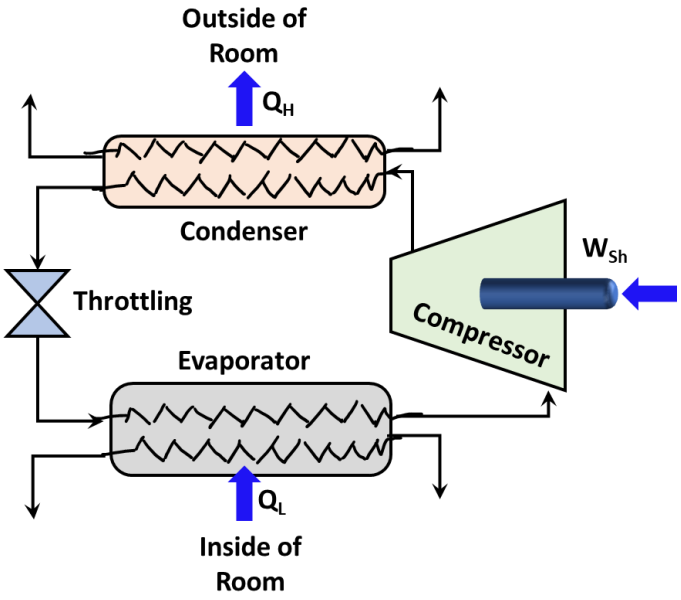
$$dP = \frac{2(\vartheta - b)}{RT} d\vartheta + \frac{(\vartheta - b)^2}{RT^2} dT$$

$$dP = -\frac{RT}{(\vartheta - b)^2} d\vartheta + \frac{R}{(\vartheta - b)} dT$$

Q12. A gas obeying the ideal gas law is entrapped in a cylinder at pressure 15 MPa is allowed to leak isothermally into the surrounding (0.1 MPa) to reach the final pressure of 10 MPa inside the cylinder. Determine the work done, if any. **(5 Marks)**

Q13. A gas is compressed reversibly from **XX*10** bar and 0.2 m^3 to 10 bar and 0.**XX** m^3 in a piston-cylinder assembly. Plot the P-v diagram of this compression and determine the work done. **(5 Marks)**

Q14. Assuming electricity is free, in winters, can a room be heated by installing an AC in a room with its back inside the room? Explain. The working of AC can be considered as shown in the figure below. **(5 Marks)**



Q15. A gas at 15 °C and 1 bar pressure undergoes an isentropic compression to reach 1/12th of its initial volume. Then it is heated reversibly at constant pressure. Then it undergoes an isentropic expansion followed by reversible constant volume cooling. If the maximum temperature reached during the cycle is 1100 °C. Draw the P-v diagram and determine the efficiency of the process. Given that the ratio of the specific heats is 1.4 and C_p is 1.005 kJ/kg. **(10 Marks)**