Minor-2, Time: 1 hour, CHL121-Thermodynamics, Take appropriate assumptions and mention them clearly, Only one A4 page original hand written notes are allowed

Problem 1: Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the net power output and thermal efficiency for this heat engine. **2**

Problem 2: A piston-cylinder device contains a liquid-vapor mixture of water at 300 K. During a constant pressure process, 750 kJ of heat is transferred to the water. As a result, part of the liquid in the cylinder vaporizes. Determine the entropy change of water during the process. **3**

Problem 3: A heat source at 800 K loses 2000 kJ of heat to a sink at a) 500 K and b) 750 K. Determine which heat transfer process is more irreversible. **5**

Problem 4: Steam enters an adiabatic turbine at 5MPa and 450 °C and leaves at a pressure of 1.4 MPa. Determine the work output of the turbine per unit mass of steam if the process is reversible. **5**

Problem 5: A 50 kg block of iron casting at 500 K is thrown into a large lake that is at a temperature of 285 K. the iron block eventually reaches thermal equilibrium with the lake water. Assuming an average specific heat of 0.45 kJ/kg. K for the iron determine (a) the entropy change of the iron block, (b) the entropy change of the lake water, and (c) the entropy generated during the process. **5**

Problem 6: Derive a general relationship for calculating residual property of gibbs energy and enthalpy by Peng-Robinson equation. **5**

$$Z = \frac{1}{1 - b\rho} - \frac{a\rho}{RT(1 + 2b\rho - b^2\rho^2)}$$

Problem 7: Derive a general formula to relate C_p and C_v **5**