# Tutorial -7

# Gas mixture and psychrometry

1. A 100 m3 storage tank with fuel gases is at 20oC, 100 kPa containing a mixture of acetylene C2H2, propane C3H8 and butane C4H10. A test shows the partial pressure of the C2H2 is 15 kPa and that of C3H8 is 65 kPa. How much mass is there of each component? Son12.2, Ans: c2h2 =16.024kg, c4h10 = 47.693kg

1. Three SSSF flows are mixed in an adiabatic chamber at 150 kPa. Flow one is 2 kg/s of O2 at 340 K, flow two is 4 kg/s of N2 at 280 K and flow three is 3 kg/s of CO2 at 310 K. All flows are at 150 kPa the same as the total exit pressure. Find the exit temperature and the rate of entropy generation in the process. son12.14, Ans: 301.8 K, s\_gen= 1.871 kw/K

3. A piston/cylinder contains 0.5 kg argon and 0.5 kg hydrogen at 300 K, 100 kPa. The mixture is compressed in an adiabatic process to 400 kPa by an external force on the piston. Find the final temperature, the work and the heat transfer in the process. Assume rev adiabatic process. Son 12.16 Ans: 451K, w12=-784.9 Ki

1. A mixture of 2 kg oxygen and 2 kg of argon is in an insulated piston cylinder arrangement at 100 kPa, 300 K. The piston now compresses the mixture to half its initial volume. Find the final pressure, temperature and the piston work. C.V. Mixture. Control mass, boundary work and no Q, assume reversible. Son12.23 Ans: p2=279 kPa, T2 =418 K, w12 =-231 kJ

1. Two insulated tanks A and B are connected by a valve. Tank A has a volume of 1 m3 and initially contains argon at 300 kPa, 10oC. Tank B has a volume of 2 m3 and initially contains ethane at 200 kPa, 50oC. The valve is opened and remains open until the resulting gas mixture comes to a uniform state. Determine the final pressure and temperature. Son 12.24 Ans: t2=315.5 k, p2= 242 kPa.

1. A spherical balloon has an initial diameter of 1 m and contains argon gas at 200 kPa, 40oC. The balloon is connected by a valve to a 500-L rigid tank containing carbon dioxide at 100 kPa, 100oC. The valve is opened, and eventually the balloon and tank reach a uniform state in which the pressure is 185 kPa. The balloon pressure is directly proportional to its diameter. Take the balloon and tank as a control volume, and calculate the final temperature and the heat transfer for the process. Son12.28, Ans: t2=361.3K, q=-2.4kJ

1. Consider 100 m3 of atmospheric air at 100 kPa, 25oC, and 80% relative humidity. Assume this is brought into a basement room where it cools to 15oC, 100 kPa. How much liquid water will condense out? Son 12.39 Ans: 0.56 kg

1. A flow moist air at 100 kPa, 40oC, 40% relative humidity is cooled to 15oC in a constant pressure SSSF device. Find the humidity ratio of the inlet and the exit flow, and the heat transfer in the device per kg dry air. Son 12.42, Ans: q=43.54 kJ/kg-dry air

1. A steady supply of 1.0 m3/s air at 25oC, 100 kPa, 50% relative humidity is needed to heat a building in the winter. The outdoor ambient is at 10oC, 100 kPa, 50% relative humidity. What are the required liquid water input and heat transfer rates for this purpose? Son 12.44, Ans: m\_dot\_water=.0071 kg/s, q\_dot=34.76 kw

1. Consider a 500-L rigid tank containing an air–water vapor mixture at 100 kPa, 35oC, with a 70% relative humidity. The system is cooled until the water just begins to condense. Determine the final temperature in the tank and the heat transfer for the process. Son 12.45, Ans: t2=28.2C, q12 = -2.77 kJ

1. A rigid container, 10 m3 in volume, contains moist air at 45oC, 100 kPa, Φ=40%.

The container is now cooled to 5oC. Neglect the volume of any liquid that might be present and find the final mass of water vapor, final total pressure and the heat transfer. Son. 12.49, Ans: p2=86.12 kPa, mv2 = .0679 kg, q12= -754.4 kJ

1. A water-filled reactor of 1 m3 is at 20 MPa, 360oC and located inside an insulated containment room of 100 m3 that contains air at 100 kPa and 25oC. Due to a failure the reactor ruptures and the water fills the containment room. Find the final pressure. Son12.53, Ans 700kpa,