Assignment 01: HVAC Systems

(Answer all the questions, each question carries equal marks)

1. Discuss the advantages and disadvantages of all-air HVAC systems. Give one example of their application in buildings and explain how the system can suit the needs of the application.

2. Two identical water pumps in a chilled water system are connected in parallel. For each water pump, the design flow rate and pump pressure are 120 litre.s^{-1} and 360 kPa, respectively. To reduce the energy consumption, the pumps are installed with variable speed drive. If both water pumps are running at 50% rated speed, calculate the flow rate, pressure and theoretical power reduction of the whole system.

3. A cooling tower of a commercial building cools 120 kg.s^{-1} of water from 35 °C to 25 °C. The inlet air to the cooling tower has a temperature of 25 °C dry bulb (DB) and 35% relative humidity (RH) (enthalpy h_1 = 42.65 kJ.kg^{-1}, moisture content w_1 = 0.0069 kg per kg of dry air, specific volume v_1 = 0.75 m^3.kg^{-1}). Air leave the cooling tower saturated at 35 °C (enthalpy h_2 = 129.07 kJ.kg^{-1}, moisture content w_2 = 0.0366 kg per kg of dry air). Calculate the volume flow rate of air required by the cooling tower in m^3.s^{-1}.

4. With the aid of suitable sketch diagram(s), explain the principle of variable-flow decoupled chilled water system in a large chiller plant. Describe the design considerations for the bypass pipe in the system.

5. Briefly explain the design and operation of a heat pipe energy recovery system. Discuss the advantages and disadvantages of the system for HVAC applications.