**Student name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ student number:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Q1 (10 points):** A central HVAC system is used for cooling purposes in a wedding hall. The average hall load equals to 200,000 kJ/hr, and it operates 600 hrs/year. The current chiller COP equals to 2.8. If the energy costs 0.2 $/kWh.

1. Estimate the savings if the chiller is replaced with a new one with 3.5 COP.
2. If ventilation fans supply 15,000 L/s now, and it was found that it can be reduced to 12,000 L/s. Calculate the savings if the fans consume 30 kW.

**Q2 (10 points):** A tank contains hot oil at 120 oC. The tank diameter is 2 m and height equal to 4 m. The tank shell thickness is 4 cm, its thermal conductivity is 42 W/m.K. It is insulated with old insulation where thermal conductivity equals to 0.1 W/m.K, with thickness equals to 5 cm. if the tank surrounding temperature equals to 29 oC, and its surface resistance equals to 0.13 m2.K/W. The oil is heated using oil#2 fuel (36 MJ/L, 5.2 Nis/L, 0.886 kg/L) using a boiler efficiency equals to 80%. If the tank is used 1000 hours per year, determine its losses annual expenses.

**Q3 (10 points):** Explain briefly how you can develop a maintenance management system in a factory you are hired at.