## HVAC PROBLEM SHEET # 01(REVERSED CARNOT CYCLE)

1. A Carnot refrigerator requires 1.3 kW per tonne of refrigeration to maintain a region at low temperature of $-38℃$. Determine: (1) C.O.P. of Carnot refrigerator; (2) Higher temperature of cycle; (3) The heat delivered and C.O.P. when this device is used as heat pump. (2.99, 40.6℃, 311.3kJ/min)

2. A refrigerating system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is $35℃$ and the lower temperature is$-15℃$. The capacity is to be 12 tonnes. Neglect all losses. Determine: (1) Co-efficient of performance; (2) Heat rejected from the system per hour; (3) Power required. (5.16, 200558kJ/h, 9.04kW)

3. Ice is formed at $0℃$ from water at $20℃$ . The temperature of the brine is $-8℃$ . Find out the kg of ice formed per kWh. Assume that the refrigeration cycle used is perfect reversed Carnot cycle. Take latent heat of ice as 335 kJ/kg.(81.35kg)

4. The capacity of a refrigerator is 450 tonnes when working between $-15℃$ and$30℃$. Find out the mass of ice produced within 24 hours when water is supplied at $20℃$ . Also, find out the minimum power required. Assume the machine to be working on Carnot cycle. Take latent heat of ice as 335 kJ/kg.(361.2tonnes,305.25kW)

5. The capacity of the refrigerator, working on reversed Carnot cycle, is 280 tonnes when operating between $-10℃$ and$25℃$. Determine: (1) Quantity of ice produced within 24 hours when water is supplied at $20℃$; (2) Minimum power (in kW) required. Assume latent heat of ice as 335 kJ/kg. (224.75tonnes, 145kW)

6. Find the least power of a perfect reversed heat engine that makes 500 kg of ice per hour at $-4℃$ from feed water at $15℃$ . Take the specific heat of ice as 2.095 and latent heat as 335 kJ/kg.(3.98kW)

7. A refrigerating system operates on the reversed Carnot cycle between temperature limits of $25℃$ and$-10℃$. The capacity is to be 8 tonnes. Determine: (1) Coefficient of performance; (2) Power rating of the compressor motor if the overall electro-mechanical efficiency is 85%; (3) Heat rejected from the system per min.(7.51, 4.87kW, 2115.07kJ/min)

8. A cold storage plant is required to store 20 tonnes of fish. The temperature of the fish when supplied =$25℃$; srorage temperature of fish required =$-8℃$; specific heat of fish above freezing point = $2.93\ kJ/kg℃$ ; specific heat of fish below freezing point = $1.25 kJ/kg℃$ ; freezing point of fish = $-3℃$. Latent heat of fish = 232 kJ/kg. (1) Capacity of the refrigerating plant; (2) Carnot cycle C.O.P. between this temperature ranges; (3) If the actual C.O.P. is 1/3rd of the Carnot C.O.P. Find out the power required to run the plant.(57.19 tonnes, 8.03, 83.3kW)

9. A Carnot refrigerator extracts 500 kJ of heat per minute from a cold room which is maintained at $-10℃$ and it is discharged to atmosphere which is at $35℃$. Find the power required to run the refrigerator.(1.425kW)

10. A Carnot refrigerator operates between temperatures of $-45℃$ and $45℃$ .Determine C.O.P. it is desired to make the C.O.P. equal to 3.5 by changing temperatures. The increase (or decrease) in upper

temperature is to be equal to the decrease (or increase) in the lower temperature. Determine the new temperatures.(2.533, 238.875K, 307.125K)