HVAC PROBLEM SHEET # 02(REVERSED BRAYTON CYCLE)

1. 500 kg of atmospheric air is circulated per hour in an open type of refrigeration installation. The air is drawn from the cold chamber at temperature 8℃ and 1bar, and then compressed isentropically to 5 bars. It is cooled at this pressure to 28℃ and then led to the expander where it expands isentropically down to atmospheric pressure and is discharged to cold chamber. Determine: (1) Heat extracted from cold chamber per hour; (2) Heat rejected to cooling water per hour; (3) C.O.P. of the system.

2. An open air cycle operated by air-refrigeration system is required to produce 6 tonnes of refrigerating effect with a cooler pressure of 11 bar abs. and a refrigerated space or region at a pressure of 1.05 bar. The temperature of air leaving the cooler is 38℃ and the air leaving the room is16℃. Calculate: (1) Mass of air circulated per minute; (2) Compressor displacement required per minute; (3) Expander displacement required per minute; (4) C.O.P.; (5) Power required per tonne of refrigeration.

3. A Bell-Coleman refrigerator operates between pressure limits of 1 bar and 8 bars. Air is drawn from the cold chamber at 9℃ , compressed and then it is cooled to 29℃ before entering the expansion cylinder. Expansion and compression follow the law $PV^{1.25}$=Constant. Calculate the theoretical C.O.P. of the system. For air take γ=1.4and C_p =1.003KJ/KgK

4. An air-refrigeration system operating on Bell-Coleman cycle takes in air from cold room at −6℃ and compresses it from 1.04 bars to 6.2bar. The index of compression being 1.28. The compressed air is cooled to 25℃.The ambient temperature is 18˚C. Air expands in an expander where index of compression is 1.38. Determine: (1) C.O.P. of the system; (2) Quantity of air circulated per minute for production of 1500 kg of ice per day at 0℃ from water at18℃; (3) Capacity of the plant. Take C_{pw}=4.18KJ/KgK (for water); C_{pa}= 1.003KJ/KgK for air and latent heat of ice =335KJ/KgK

5. A refrigerating machine of 6 tonnes capacity working on Bell-Coleman cycle has an upper limit of pressure of 5.2 bars. The pressure and temperature at the start of the compression are 1.0 bar and 16℃ respectively. The compressed air cooled at constant pressure at a temperature of 41℃ enters the expansion cylinder. Assuming both expansion and compression processes to be adiabatic with $\gamma = 1.4$, calculate: (1) C.O.P.; (2) Quantity of air in circulation per minute; (3) Piston displacement of compressor and expander; (4) Bore of compressor and expansion cylinders. The unit runs at 240 rpm and is double-acting. Stroke length =200 mm; (5) Power required to drive the unit; for air take γ =1.4and C_p =1.003KJ/KgK

6. A dense air refrigeration cycle operates between 5 bars and 20 bars. The air temperature after heat rejection to surroundings is 37℃ and air temperature at exit of refrigerator is7℃. The isentropic efficiencies of compressor and turbine are 0.84 and 0.82 respectively. Determine: (1) Compressor and turbine work per tonne of refrigeration; (2) C.O.P.; (3) Power per tonne of refrigeration. Take γ =1.4and C_p =1.003KJ/KgK

7. A dense air closed Bell-Coleman refrigeration system working between 4 bars and 16 bars extracts 125 MJ/h. The air enters the compressor at 5℃ and enters the expander at 23˚C. The compressor is double-acting and its stroke = 30cm; γ=1.4and C_p =1.003KJ/KgK; η=87%; C_p =1.005; R_{air}=0.287KJ/KgK.Assuming the unit runs at 300 rpm. Find: (1) Power required running the unit; (2) Bore of the compressor; (3) Refrigerating capacity in tonnes. Assume isentropic compression and expansion.