QUESSTION BANK UNIT 2

Q1. A perfect gas flows through a nozzle where it expands in a reversible adiabatic manner. The inlet conditions are 22bar and 5500 C, 38m/s. At exit the pressure is 2 bar. Determine the exit velocity and exit area if flow rate is 4 kg/s. Take R=190 kj/kg k & $\gamma = 1.35$

Q2. A steam turbine working under steady flow conditions receiving steam at the following state: pressure 15 bar, internal energy 2700 kj/kg; specific volume 0.17m3 /kg; and velocity 100m/s.

The exhaust of steam from the turbine is at 0.1bar with internal energy 2175kj/kg, specific volume 15 m3 /kg and velocity 300 m/s. The intake is 3 m above the exhaust the turbine develops 35 Kw and heat loss over the surface of turbine is 20Kj/Kg K. Determine the steam flow rate through the turbine.

Q3. A heat engine working on a Carnot cycle converts one fifth of the heat input into work. When the temperature of the sink is reduced by 800C, the efficiency gets doubled. Make calculation for the temperature of source and sink.

Q4. A reversible heat engine delivers 0.6 KW power and rejects heat energy to a reservoir at 300K at the rate of 24kj/min. make calculation for the engine efficiency and the temperature of the thermal reservoir supplying heat to the engine.

Q5. A refrigerator operating on a reversed Carnot cycle consumes 150W power in summer when the ambient atmosphere is at 310K. The heat leakage into the refrigerator through the doors is estimated to be at the continuous rate of 15W per degree temperature difference between the ambient air and cold space of the refrigerator. For continuous operation of the refrigerator determine the temperature at which the cold space is maintained.

Q6. A Carnot engine E1operates between temperatures T1 & T2, rejects its waste heat at sink temperature T2 to Carnot engine E2 which operates between temperatures limits T2 & T3. Setup an expression relating the thermal efficiency of engines E1 & E2 to that of Carnot engine E3 operating directly between temperature T1 & T3.

Q7. Two reversible heat engine E1 and E2 are kept in series between a hot reservoir at temperature T1 of 600K and cold reservoir at temperature T2 of 300K. Engine E1 receives 500Kj of heat from the reservoir at T1. Presuming that both the engines have equal thermal efficiency determine;

a) Temperature at which heat is rejected by engine E1 and is received by engine E2

b) Thermal efficiency of each engine

c) Work done by each engine

d) Heat rejected by engine E2 cold reservoir.

Q8. Three Carnot engine E1, E2, E3 operates between temperatures of 1000K and 300K. Make calculation for the intermediate temperatures if the work produced by the engines are in the ratio of 4:3:2.

Q9. State the Kelvin Planck and Clausius statements of 2nd law of thermodynamics.
Q10. Show the equivalence of two statements of 2nd law of thermodynamics.
Q11. Write short notes on the following:

Q12. Heat reservoir, Heat engine, Heat pump and refrigerator.
Q13. Explain the reversible and irreversible processes.
Q14. Describe Carnot cycle and obtain expression for its efficiency as applied to a heat engine.
Q15. Why Carnot cycle is a theoretical cycle? Explain.
Q16. Show that coefficient of performance of heat pump and refrigerator can be related as;

$$COPRef = COPHP - 1$$

Q17. State Carnot theorem. Also prove it.
Q18. Show that the efficiencies of all reversible heat engines operating between same temperature limits are same.
Q19. Show that efficiency af an irreversible engine is always less than the efficiency of reversible engine operating between same temperature limits.