COURSE – THERMODYNAMICS AND STATISTICAL MECHANICS

PRACTICE SET - 1(LAWS OF THERMODYNAMICS) **Date: 07-06-2017**

1 (a) The temperature of dry air at 15^0 C is adiabatically compressed to half of its volume. Calculate the final temperature if $\gamma = 1.4$

(b) A motor tyre is pumped to a pressure of 2 atm at $15^0 C$ then it suddenly bursts. Calculate the resulting drop in temperature.

2 How many atm pressure would be required and what would be the rise in temperature if a mass of dry gas at NTP were compressed to one- twentieth of its volume (i) very slowly (ii) suddenly?

3 Calculate the amount if work done when one litre of a monoatomic perfect gas originally at NTP, is compressed adiabatically to half its volume.

4 A quantity of oxygen is compressed isothermally until its pressure is doubled. It is then allowed to expand adiabatically until its original volume is restored. Its pressure was then found to be 0.758 of the initial value. Calculate γ.

5 A Carnot engine has an efficiency of 50% when its sink temperature is 27^0 C. What should be the change in its source temperature so that its efficiency may become 60%?

6 A Carnot engine has its source at 100^0 C and sink at 0^0 C. If it is working at the rate of 100 watts, how much ice at 0^0 C will melt away in one minute? Given 1 Cal = 4.2 Jules, L = 80000 Cal/kg.

7 A Carnot refrigerator takes heat from water at 0^0C and discards it to the room at $27^0 C$. If 1 kg of water is to be changed into ice how many calories are discarded to the room? What is the work done by the refrigerator in this process? What is the coefficient of performance of the machine? If L=80 Cal/gm.

8 A reversible Carnot engine converts one sixth of heat into work. When the temperature of the sink is reduced by 82^0 C it converts one third of the heat received into useful work. Compute temperature of the source and sink.

9 The ice in a cold storage melts at the rate of 2kg per hour with the external temperature at $20^0 C$. Find the minimum power output of the motor used to drive the refrigerator which converts the ice from melting.

10 Two Carnot engines A and B are operated in series. First engine absorbs heat at 1100 K and rejects it to sink at T K. Second engine B absorbs half amount of heat rejected by first and rejects heat to the sink at 200K. If the work performed by both the engines is equal calculate T.