(3 Hours) **[Total Mark: 80]**

N.B. (1) Question No. 1 is compulsory
(2) Attempt any **Three** Question from Q. No. 2 to Q. No.6
(3) Make suitable assumption if required
(4) Illustrate answers with sketches wherever required

Q. 1 Solve any **four** questions from following **(Five marks each)** 20

a) Define and explain on PV diagram the following
i) Thermodynamic state ii)Thermodynamic process iii)Thermodynamic cycle
b) Explain Carnot theorem and its corollaries and give the reasons for impracticability of Carnot cycle.
c) Define Helmoltz and Gibbs function
d) What are the assumption of air standard cycles?
e) Define stagnation and static properties and also explain the Stagnation enthalpy, stagnation pressure and stagnation temperature.

Q. 2 (a) A gas is contained in a vertical cylinder fitted with a piston loaded with small number of weights. The initial pressure of the gas is 1.3 bar, and the initial volume is 0.03 m^3. The gas is now heated until the volume of the gas increases to 0.1 m^3. Calculate the work done by the gas in the following process 12

a. Pressure remain constant
b. Temperature remains constant
c. $PV^{1.3} = C$ during the process

Explain, how such processes could be achieved? Show the processes on p-v diagram

(b) Differentiate between Heat and work energy. Also explain with an example high grade and low grade energy. 08

Q. 3 (a) Define Dryness fraction, Degree of superheat, critical point, triple point& latent heat. 10

(b) Explain the two statements of Second law of thermodynamics. Why PPM1 and PMM2 is Impossible. Why second law is called law of degradation? 10

Q. 4 (a) Consider 1 kg of ice at -15 °C as a system, it is exposed to surrounding at 30° C, the ice melts to water ultimately coming to equilibrium with the surrounding. Find 12

a. The entropy change of the system, the surroundings and the universe
b. Determine the minimum amount of work required to restore the melted water back to the initial state of ice. Assume Cp_{ice} = 2.095kJ/kgK, and h_{sg} = 333.5 kJ/kg for water.

(b) Show that entropy is a property of the system 08

Q. 5 (a) Derive an equation of air standard efficiency of otto cycle 12

(b) Derive Maxwell's equations 08

Q. 6 (a) In a Rankine cycle the stream at the inlet to the turbine is at 100 bar and 500^0C. If the exhaust pressure is 0.5 bar, determine the pump work, turbine work, condenser heat flow and Rankine efficiency. 08

(b) An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at 100 kPa and 17 C and 800 kJ/kg of heat is transferred to air during the constant volume heat addition process. Accounting for the variation of specific heats of air with temperature, determine 12

a) The maximum temperature and pressure that occur during the cycle
b) The network output
c) The thermal efficiency

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