3 Hours **Marks : 80**

NOTE:

- Question No 1 is **COMPULSORY**.
- Attempt any **THREE** questions out of remaining questions.
- Assume suitable data wherever required.
- Illustrate answers with sketches wherever required.
- Use of steam table, Gas table and Mollier chart is permitted.

Q. 1 Solve the following **(any FIVE)** **20**

(a) Define adiabatic process. Draw PV and TS diagram and derive equation for work done.
(b) Differentiate between Intensive and extensive properties with example.
(c) Explain Closed, Open and Isolated system with neat sketch.
(d) Explain Dual cycle with help of P-V and T-S diagram.
(e) What is Joule-Thomson coefficient? State its significance.
(f) Differentiate between compressor and blower.

Q. 2 (a) Differentiate between High grade and Low-Grade Energy with example. **04**

(b) Define dead state and irreversibility. **04**

(c) A perfect gas undergoes a cycle comprises of three processes. It is first compressed isothermally from 1 bar and 27 ˚C to one-eighth of its initial volume. The energy is then added at constant pressure, increasing the temperature of gas and the cycle is completed by isentropic expansion to original conditions. Take Cp=1.25 kJ/kgK and R = 0.5 kJ/kg.K. Determine: (i) maximum cycle temperature and pressure (ii) net work done per kg of gas. Draw P-V diagram. **12**

Q. 3 (a) Define Dryness fraction, Degree of superheat, critical point, triple point & latent heat. **04**

(b) Write the limitations of the Carnot vapour power cycle. **04**

(c) Air flows steadily at the rate of 0.5 kg/s through an air compressor entering at 7 m/s velocity, 100 kPa pressure and 0.95 m^3/kg specific volume and leaving at 5 m/s, 700 kPa and 0.19 m^3/kg respectively. The internal energy of the air leaving is 90 kJ/kg greater than of air entering. Cooling water in the compressor jacket absorbs heat from the air at the rate of 58kW. Calculate (i) Power input to the compressor (ii) ratio of inlet pipe diameter to outlet pipe diameter. **12**

Q. 4 (a) The boiler produces dry and saturated steam at 30 bar. The steam expands in the turbine to a condenser pressure of 20 kPa. Compare the work done and thermal efficiency of Carnot and Rankine cycles for these conditions. Neglect Pump work. **10**

(b) State and prove Clausius inequality theorem. **10**

Q. 5	(a)	Explain the construction & working principle of Stirling cycle. Show on PV & TS diagram.	**05**
	(b)	State and explain the equivalence of Kelvin Planck statement and Clausius statement of second law of thermodynamics.	**05**
	(c)	A single stage single acting reciprocating air compressor delivers 0.6 kg/min of air at 6 bar. The temperature and pressure at the suction stroke are 30 °C and 1 bar respectively. The bore and stroke are 100 mm and 150 mm respectively. The clearance volume is 3% of the swept volume and index of expansion and compression is 1.3. Determine: (i) volumetric efficiency (ii) Power required if mechanical efficiency is 85% (iii) Speed of the compressor.	**10**
Q. 6	(a)	An engine working on dual cycle has a pressure of 1 bar temp of 50 °C before compression. Air is then compressed isentropically to $1/15^{th}$ of its original volume. The maximum pressure is twice the pressure at the end of the isentropic compression. If the cut off ratio is 2, Determine: temperature at the end of each process and efficiency of the cycle.	**12**
	(b)	Write Maxwell equations.	**04**
	(c)	Write the uses of the compressed air.	**04**
