(3 Hours) **Total marks: 80**

1) **Question No 1 is compulsory.**
2) Attempt any three out of remaining five questions.
3) Figures to the right indicate full marks.
4) Assume suitable data if required.
5) Use of steam Table and moiller chart permitted.

Q. 1) Attempt any five **20**

a) List the steady flow processes. Obtain an expression for work done in case of Isothermal process.

b) 2 kg of steam is at10 bar and 0.90 dry. Determine its enthalpy and specific volume.

c) Explain Intensive and extensive properties with examples.

d) Explain briefly First law of thermodynamics and explain its significance.

e) Define availability ,unavailability and irreversibility

f) Explain the term co-efficient of performance in content of (1) Refrigerator (2) Heat pump. Prove that (COP)HP=(COP)ref+1

Q. 2)

a) A fluid is contained in a cylinder by a spring loaded frictionless piston so that the pressure in the fluid is a linear function of the volume(P=a+bV).The internal energy of the fluid is given by the following equation=42+3.6pV**.**
Where U is in KJ,P is in KPa and V in m^3/kg.If the fluid changes from an initial state of 190KPa,0.035$m^3$to a final state of 420KPa,.07m^3,with no work other than that done on the piston. Find the direction and magnitude of the work and heat transfer. **10**

b) Explain in brief inversion curve and joule Thompson coefficient **05**

c) Derive an expression for work done in a Adiabatic process executed by a closed system. **05**

Q. 3)

a) At the inlet to a certain nozzle the enthalpy of fluid passing is 2800KJ/kg
And the velocity is 50m/s. At the discharge end the enthalpy is 2600KJ/kg.The nozzle is horizontal and there is negligible heat loss from it.

(i) Find the velocity at the exit of the nozzle,

(ii) If the inlet area is 900cm^2 and the specific volume at inlet is 0.187m^3/kg,find the mass flowrate.

(iii) If the specific volume at the nozzle exit is 0.498m^3/kg. Find the exit area of the nozzle. **10**

b) State the Kelvin-Planck and Clausius statement of the second law of thermodynamics and explain the same in brief. **06**

c) Write the steady flow energy equation and apply it to – i) Boiler ii) condenser **04**

Q.4)

a) An engine with cylinder diameter 200mm and 300mm stroke works on theoretical Diesel cycle. The initial pressure and temperature of air is 1bar and 27ºC.The cut-off is 8% of the stroke. Determine (i) Pressures and temperatures at the all points, (ii) Air standard efficiency (iii) Power of the engine if the working cycles per minute are 380. Assume that compression ratio is 15 and working fluid is air. **10**

b) State and explain clausius inequality. **05**

c) Explain principle increase of entropy. **05**

Q. 5)

a) Derive an expression for air standard efficiency of Diesel cycle. **08**

b) Two Carnot engines work in series between the source sink temperatures of 550K and 350K.If both the engines develop equal power determine the intermediate temperatures. **12**

Q. 6)

a) In a Rankine cycle the steam at the inlet to the turbine is at 20MPa and 450^0 C and the exhaust pressure is 0.4 bar. Determine the pump work, turbine work, condenser heat flow and Rankine efficiency . **10**

b) State the Zeroth law of thermodynamics. What is its significance? **04**

c) Explain methods to improve the efficiency Rankine cycle. **06**
