(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 pressure process.

b) 2 kg of steam is at12 bar and 0.95 Dry determine its enthalpy and specific volume.

c) Explain Intensive and extensive properties with examples.

d) Compare Otto, Diesel and Dual cycle based on same compression ratio?

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 fallowing equation=42+3.6pV**.**

Where U is in KJ,P is in Kpa and V in m3/kg.If the fluid changes from an initial state of 190Kpa,0.035m3to a final state of 420Kpa,.07m3,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 polytropic process executed by a closed system. **05**

Q.3)

a) In a gas turbine unit, the gases flow through the turbine is 15kg/s and the power developed by the turbine is 12000kW.The enthalpies of gases at the inlet and the outlet are 1260kJ/kg and 400KJ/kg respectively, and the velocity of gases at the inlet and outlet are50m/s and 110m/s respectively. Calculate:

(i) The rate at which heat is rejected to the turbine.

(ii)The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45m3/kg. **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 –1) Nozzle 2)Turbine **04**

Q.4)

a) The stroke and cylinder diameter of a compression ignition engine are 250mm and 150mm respectively. If the clearance volume is 0.0004m3 and fuel injection takes place at constant pressure for 5% of the stroke, determine the efficiency of the engine. Assume the engine working on the diesel cycle. **10**

b) State and explain Carnot's theorem. **05**

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

Q.5)

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

b) Three Carnot engine R1, R2, R3operate in series between two heat reservoirs which are at 1000k and 300k. Calculate the intermediate temperatures if the amount of work produced by the engine is in the proportion of 5:4:3. **12**

Q.6)

a) In a Rankine cycle the steam at the inlet to the turbine is at 20bar and 360^0 C and the exhaust pressure is 0.08bar 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 Reheat and regenerative Rankine cycle. **06**
