Time: 2 Hours **Marks: 60**

N.B

1. **Question No1 is compulsory**
2. **Attempt any three question out of five questions**
3. **Assumption made, if any should be clearly stated**
4. **Figure to the right indicate full marks**

Q.1		**Solve any three**	**15**
	a)	Differentiate heat engine and heat pump	
	b)	Explain with neat sketch joule Thomson coefficient	
	c)	Sketch and explain T-S diagram	
	d)	Explain compressibility factor	
	e)	Derive Clausius inequality theorem	
Q.2	a)	A reversible engine receives 75 kJ/s of energy from a source at 750 K and does 10 kJ/s of work. The heat is rejected to two sinks at 650 K and 550 K, respectively. Find the amount of heat rejected to the two sinks.	**10**
	b)	Prove that for Vanderwall gas $\frac{P_C V_C}{RT_C} = \frac{3}{8}$	**5**
Q.3	a)	A compressor is required to deliver air at 0.5 MPa and 200°C (473 K) to a stationary power plant. The air intake is at 0.1 MPa and 20°C (293 K). The outlet velocity is 25 m/s. Calculate the work per unit mass required for an adiabatic compressor. **Data:** C_p for air = 1.0052 kJ/(kg·K) and is constant over the temperature range given	**5**
	b	Derive maxwell relation	**10**
Q.4	a)	Find enthalpy and entropy departure relation for Redlich-kwong equation of state.	**10**
	b)	Derive relation for first law of thermodynamics for open system	**5**
Q.5	a)	Derive Vanderwall equation constant a and b	**10**
	b)	10 Kg iron ingot at 500K is dropped in 50kg of oil at 323k the surrounding is at 298k. Find total entropy change. Data: Cp oil= 2KJ/kg.K, Cp iron = 0.4 KJ/kg.K	**5**
Q.6	a)	Determine Q, W, ΔU and ΔH for each step of process in which argon is compressed isothermally at 500K, 0.2 to 3Mpa, is cooled isobarically to 300K, is expanded adiabatically to 1.0Mpa, is expanded isothermally to its initial value and is then heated isobarically to 500K Data: Cp = 3.5 R kJ/kmole,K Cv= 2.5RkJ/kmol,K R= 8.314kJ/Kmole,K	**10**
	b)	Explain H-s diagram	**5**

****

X525Y4F4373X525Y4F4373X525Y4F4373X525Y4F4373