Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E Sem-IV Examination June 2010

Subject code: 141903

Subject Name :Engineering Thermodynamics

Date: 17 / 06 /2010 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of molier chart and steam tables is permitted**

Q.1 **(a)** Describe the phase change process of water using a T-V diagram. **04**

(b) Recognize whether the system is open, closed or isolated. **03**

1. A tube of bicycle filled with air
2. A jet engine in flight
3. water pump
4. car battery
5. An Electric geyser
6. Thermos flask

(c) Air at a temperature of 15°C passes through a heat exchanger at velocity of 30 m/s where temperature is raised to 800°C. It then enters a turbine with same velocity of 30m/s and expands until temperature falls to 650°C. On leaving the turbine the air is taken at velocity of 60m/s to a nozzle where it expands until the temperature has fallen to 500°C, If the air flow rate is 2kg/s, calculate (a) rate of heat transfer to air in the heat exchanger, (b) power output from turbine assuming no heat loss and (c) velocity at exit from the nozzle. Assuming no heat loss. **07**

Q.2 **(a)** Define following terms: Kelvin Plank statement, Third law of Thermodynamics, Thermodynamic temperature scale, Exergy **04**

(b) Derive Maxwell's thermodynamics relation and explain their importance in thermodynamics. **03**

(c) A reversed carnot cycle operates at either a refrigerator or heat pump. In either case, the power input is 20.8 kW. Calculate the quantity of heat extracted from the cold body for either type of machine. In both case 3500 kJ/min heat is delivered by the machine. In case of the refrigerator the heat is transferred to the surroundings while in case of heat pump, the space is to be heated. What is their respective coefficient of performances? If the temperature of cold body is 0°C for the refrigerator and 5°C for heat pump what will be respective temperatures of surrounding for refrigerator and heated space for heat pump? What reduction in heat rejection temperatures would be achieved by doubling the COP for same cold body temperature? **07**

OR

(c) A volume of 0.14 m^3 of air at 1 bar and 90°C is compressed to 0.014m^3 according to the law $pv^{1.3}$= C . Heat is then added at constant volume the pressure is 66 bar. Determine (a) Heat exchange with cylinder walls during compression and (b) Change of entropy during each portion of the process. Assume γ=1.4 and R=286 J/Kg K **07**

Q.3 **(a)** With usual notations prove that $\Phi\delta Q/T <= 0$ **04**

(b) Explain following terms: Flow work, critical point, triple point. **03**

	(c)	10 Kg of water undergoes transformation from initial saturated vapour at 150 °C, velocity of 25 m/s and elevation of 10 m to saturated liquid at 20°C, velocity of 10m/s and elevation of 3m. determine the availability of for initial state, final state and change if availability considering environment to be taken at 0.1 MPa and 25°C C and g=9.8 m/s^2	**07**
		OR	
Q.3	**(a)**	Show that entropy of universe during mixing of flow fluid always increases.	**04**
	(b)	Explain following terms: Joule Thomson coefficient, Helmholtz function.	**03**
	(c)	Two Kg of air at 500 KPa, 80°C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of surrounding which is at 100 kPa, 5 °C . For this process, determine (a) maximum work, (b) Change in availability and irreversibility , for air take C_v =0.718 kJ/Kg K, R=0.287 kJ/Kg K	**07**
Q.4	**(a)**	Show that the COP of heat pump is greater than the COP of refrigerator by unity.	**04**
	(b)	An engine uses 6.5 Kg of oil per hour of calorific value of 30,000 kJ/Kg. If the Brake power of engine is 22 kW and mechanical efficiency is 85% calculate (a) indicate thermal efficiency (b) Brake thermal efficiency (c)Specific fuel consumption in Kg/B.P/hr.	**03**
	(c)	A carnot cycle works on steam between the pressure limits of 7 MPa and 7KPa. Determine the thermal efficiency, turbine work and compression work per kg of steam.	**07**
		OR	
Q.4	**(a)**	With suitable T-S diagram explain methods of improving efficiency of Rankine cycle.	**04**
	(b)	In an Otto cycle the temperature at the beginning and end of the isentropic compression are 316K and 596K respectively. Determine the air standard efficiency and compression ratio.	**03**
	(c)	Explain briefly the Otto cycle with help of P-V and T-S diagram and derive an expression for deal efficiency of Otto Cycle.	**07**
Q.5	**(a)**	Explain following terms: Excess air, Adiabitic flame temperature, Enthalpy of formation,	**04**
	(b)	With neat sketch explain construction and working of Junkers gas calorimeter	**03**
	(c)	A vessel of volume 0.4 m^3 consists of 0.45 Kg of carbon monoxide and 1 kg of air at 15°C. Calculate the partial pressure of each constituents and total pressure in the vessel. The partial pressure of each constituent and total pressure in the vessel. The air contains 23.3% oxygen and 76.6% nitrogen by mass. Take the molar mass of carbon monoxide, oxygen and nitrogen as 28, 32 and 28Kg/ K mole, respectively.	**07**
		OR	
Q.5	**(a)**	Write down Vanderwall's equation of state. How does it differ from ideal gas equation?	**04**
	(b)	Explain Dalton's law of partial pressure and Avogadro's law.	**03**
	(c)	How are fuels classified? List advantages and disadvantages of solid fuels over liquid fuel.	**07**

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