BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY-DUBAI
I YEAR Ist SEMESTER 2008-2009
COURSE: ES C112 Thermodynamics
Test : 1 [Closed Book]

Max.Marks :25 **Date :26 /10/2008**
Weightage :25 % **Time : 50 min**

[COMMON TO ALL BRANCHES]

Note: (i) Answer all Question
(ii) Assume suitable value if required
(iii) Thermodynamics tables are permitted

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1. A 1 m^3 container is filled with 400 kg of granite stone, 200 kg of dry sand and 0.2 m^3 of water as shown in Fig.1. Use Air density = 1.1 kg /m^3, Granite stone density = 2750 kg /m^3, Dry sand density= 1500 , Water density= 997kg/m^3 . Find the average specific volume and density of the 1 m^3 volume. **[4 Marks]**

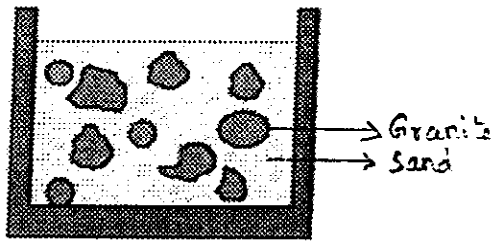

Fig.1

2. Consider two tanks, A and B, connected by a valve, as shown in Fig. 2. Each has a volume of 200 L and tank A has R-12 at 25°C, 10% liquid and 90% vapor by volume, while tank B is evacuated. The valve is now opened and saturated vapor flows from A to B until the pressure in B has reached that in A, at which point the valve is closed. This process occurs slowly such that all temperatures stay at 25°C throughout the process. How much has the quality changed in tank A during the process? **[7 Marks]**

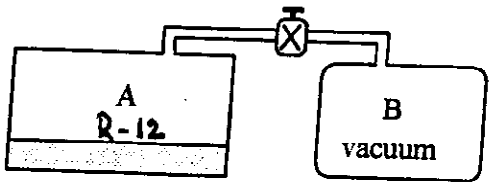

Fig.2

3. A 10-m high cylinder, cross-sectional area 0.1 m^2, has a massless piston at the bottom with water at 20°C on top of it, shown in Fig.3. Air at 300 K, volume 0.3 m^3, under the piston is heated so that the piston moves up, spilling the water out over the side. Find the work done by the air when all the water has been pushed out. Neglect the thickness of the piston. [Assume g=9.807 m/s^2, R=0.287 kJ/kg-K, P_{atm}=101.325kPa]. **[8 Marks]**

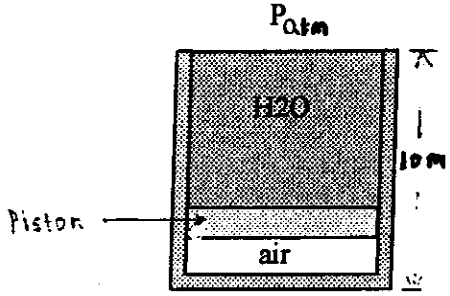

Fig.3

4. A balloon behaves such that the pressure inside is proportional to the diameter squared. It contains 2 kg of ammonia at 0°C, 60% quality. The balloon and ammonia are now heated so that a final pressure of 600 kPa is reached. Considering the ammonia as a control mass, find the amount of work done in the process.

[6 Marks]

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BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY-DUBAI
I YEAR Ist SEMESTER 2008-2009
COURSE: ES C112 Thermodynamics
Test : II [Open Book]

Max.Marks:40 **Date :14 /12/2008**
Weightage: 20 % **Time : 50 min**

Note: (i) Answer all Question
(ii) Assume suitable value if required
(iii) Thermodynamics tables are permitted
(iv)Show stepwise calculation indicating the units wherever it is required
[Assume g=9.807 m/s^2, P_{atm}=101.325kPa].

1. A cylinder contains 0.45 m^3 of a gas at 1 X 10^5 N/m^2 and 80°C. The gas is compressed by **polytropic process** to a volume of 0.13 m^3, the final pressure being 5 X 10^5 N/m^2. Determine: (i) The mass of Gas (ii) The value of index **'n'** for compression (iii) The increase in internal energy of the gas(iv) **Work done** and **Heat transfer** during the compression process.[Assume γ = **1.4** and **R = 294.2 J/kg-° C** and Temperature(K) = 273+ T(°C)] **[13 Marks]**

2. A nozzle is a device for increasing the velocity of a steadily flowing stream as shown in Fig.1. **At the Inlet to a certain nozzle** the enthalpy of the fluid passing is 3000 kJ /kg, velocity is 60 m/s, inlet area is 0.1 m^2 and the specific volume is 0.187 m^3 / kg. **At the exit of the Nozzle** the enthalpy is 2762 kJ /kg and the specific volume is 0.498 m^3 / kg. The nozzle is horizontal and there is negligible heat loss from it. Determine:
   a) Find the velocity at exit from the nozzle
   b) Find the mass flow rate
   c) Find the exit area of the nozzle
   d) Find the ratio of the inlet diameter to outlet diameter of the Nozzle.

[13 Marks]

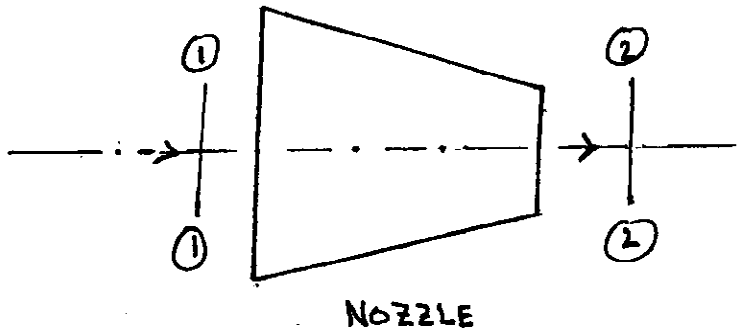

Fig.1

3. A heat pump working on the carnot cycle takes in heat from a reservoir at 5 ^{0}C and delivers heat to a reservoir at 60 ^{O}C as shown in Fig 2. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840 ^{0}C and rejects heat to reservoir at 60 ^{0}C. The reversible heat engine also drives a drilling machine that absorbs 30 kW. If the heat pump extracts heat 17 kW from the 5 ^{0}C reservoir, Determine:

a) The rate of heat supply from the 840 ^{0}C source.

b) The rate of heat rejection to the 60 ^{0}C sink from the heat engine

c) The rate of heat delivered to the 60 ^{0}C sink from the heat pump

[14 Marks]

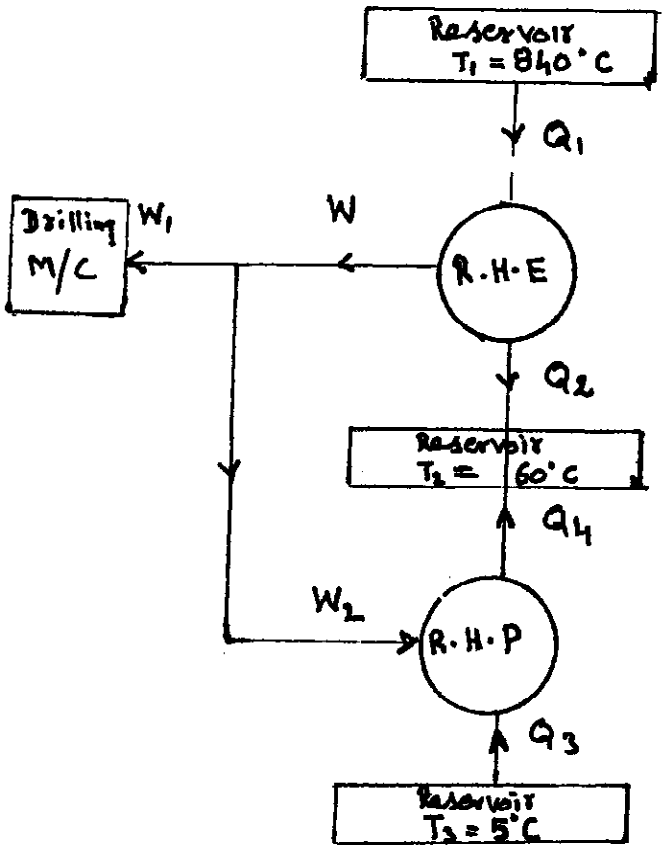

Fig.2

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BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
1st Year First Semester -2008-2009
Course: ES C112 Thermodynamics
Comprehensive Examination [Closed Book]

Max.Marks:40 **Date: 04-01-2009**
Weightage: 40 % **COMMON TO ALL BRANCHES** **Time: 3 hours**

Note: (i) Answer all Question in a sequence (ii) Assume suitable value if required (iii) Thermodynamics tables are permitted (iv) Answer Every Question on a fresh page
(v) Answer the questions of part A in the BLUE COLOUR and part B in the GREEN COLOUR

PART: A

1. Air at 200 kPa, 30°C is contained in a cylinder/piston arrangement with initial volume 0.1 m^3. The inside pressure in the cylinder is given by $P = (P_0 + C\,V^{0.5})$, where C is constant, V is volume and P_0 is ambient pressure = 100 kPa. Now heat is transferred to the system to a final pressure of 225 kPa. Find the final temperature and the work done in the process. **[6 Marks]**

2. A rigid tank is divided into two rooms by a membrane, as shown in Fig.1. Room **'A'** contains water vapor mixture at pressure P = 200 kPa, specific volume v = 0.5 m^3 / kg, V_A = 1 m^3, and room **'B'** contains superheated steam of mass 3.5 kg at 0.5 MPa, 400°C. The membrane now ruptures and heat transfer takes place, so that the both come to uniform state at 100°C. Find the heat transfer during the process. **[7 Marks]**

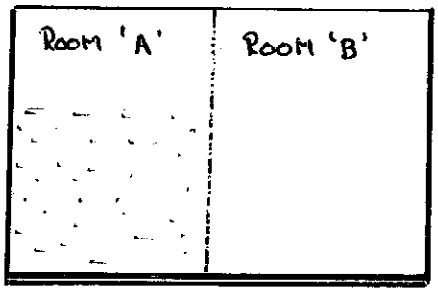

Fig.1

3. A reciprocating air compressor takes the volume flow rate in 2 m^3 / min at 0.11 MPa, 20 ^{0}C which it delivers at 1.5 MPa, 111 ^{0} C to an after cooler where the air is cooled at constant pressure to 25 ^{0}C as shown in Fig.2. The heat loss observed by the compressor is 0.163 kW. For the steady flow process determine the work done in the compressor and the rate of heat transfer to the air in the

cooler. Take the enthalpy of air as $h = c_p T$, **Assume:** (a) Specific heat for air $c_p = 1.005$ kJ/kg.K, (b) Neglecting change in K.E and P.E in both compressor and cooler (c)There is no work done in the cooler.(d) $R = 0.287$ kJ/kg.K **[7 Marks]**

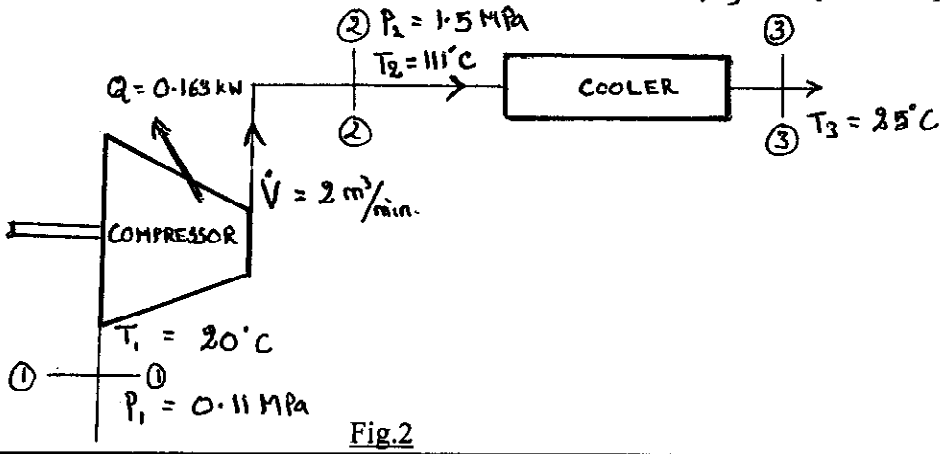

Fig.2

PART: B

1. A reversible heat engine operates between 600 ^{0} C and 40 ^{0} C and the heat received by the heat engine is 2100 kJ (Q_1) as shown in Fig.3. The work output from the heat engine is used to drives a reversible refrigerator operating between 40 ^{0} C and - 18^0 C. Determine the cooling effect by the refrigerator (Q_3). **[7 Marks]**

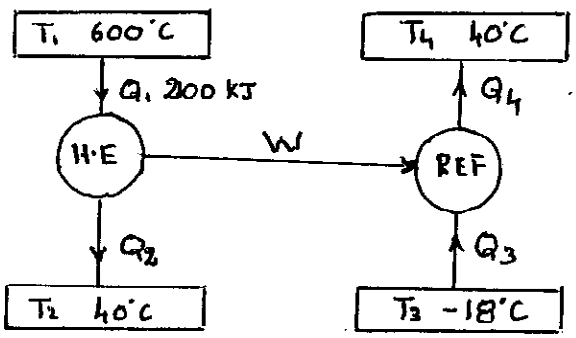

Fig.3

2. A closed tank, V = 10 L, containing 5 kg of water initially at 25°C, is heated to 175°C. Find the heat transfer to the water and the change in entropy. **[6 Marks]**

3. Steam enters an adiabatic turbine steadily at 3MPa and 400 °C and leaves at 50 kPa, 100 °C. If the power output of the turbine is 2MW, calculate a) isentropic efficiency of the turbine b) mass flow rate of the steam. **[7 Marks]**

**************All the Best***************