BITS, PILANI DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
I Year First Semester 2011-2012

Course: ES C112 / BITS F111 Thermodynamics

Comprehensive Examination [Closed Book]

Max.Marks:80 **Date: 7-1-2012**
Weightage: 40 % **Time: 3 hours**

COMMON TO ALL BRANCHES

*Note: (i) Answer all Questions in a sequence (ii) Assume suitable value if required (iii) Thermodynamics Datebook is permitted (iv) Answer Every Question on a fresh page (v) Answer the questions of **Part A , Part B and Part C separately***

PART A

1. (a)A piston/cylinder with cross sectional area of 0.01 m^2 has a piston mass of 100 kg resting on the stops. With an outside atmospheric pressure of 100 kPa, what should the water pressure be to lift the piston? **(5)**

   (b)A rigid closed tank of volume 3 m^3 contains 5 kg of wet steam at a pressure of 200 k Pa. The tank is heated until the steam becomes dry saturated. Determine the final pressure and the heat transfer to the tank. **(10)**

2. Air goes through a polytropic process from 125 kPa, 325 K to 300 kPa and 500 K. Find the polytropic exponent n and the specific work in the process **(10)**

PART B

1. (a) Ammonia is contained in a sealed rigid tank at 0°C, quality, x = 50% and is then heated to 100°C. Find the P_2, u_2, specific work and heat transfer. **(10)**

   (b).Give the Kelvin-Planck and Clausius Statement for II law of thermodynamics. **(5)**

2..(a) A diffuser has air entering at 100 kPa, 300 K, with a velocity of 200 m/s. The inlet cross-sectional area of the diffuser is 100 mm^2. At the exit, the area is 860 mm^2, and the exit velocity is 20 m/s. Determine the exit pressure and temperature of the air. **(10)**

   (b) Compare the performance of a nozzle and a diffuser and write their energy equations for adiabatic conditions and non-adiabatic conditions. **(5)**

PART C

1. A heavily-insulated cylinder fitted with a frictionless piston contains ammonia at 5°C, 92.9% quality, at which point the volume is 200 L. The external force on the piston is now increased slowly, compressing the ammonia until its temperature reaches 50°C. Find the work done and heat transferred during the process. Represent the process in a T-S and T-v diagram **(15)**

2. (a)Give the expression for isoentropic efficiency of a Compressor ,a Nozzle and a Turbine. **(6)**

   (b)Represent the entropy change in a T-s diagram for the actual and ideal process occurring in a turbine where the initial state is a super heated vapour and final state is a saturated mixture. **(4)**

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BITS, PILANI DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY

FIRST SEMESTER 2011-12

COURSE: BITS F111 / ES C112 Thermodynamics

Test 2 (Open Book)

Max. Marks: 40 **Date: 4.12.11**

Weightage: 20% **Time: 50 min**

Note: Answer all the Questions and Assume suitable value if required

1. Air at 101.325 kPa, 20°C is taken into a gas turbine power plant at a velocity of 140 m/s through opening of 0.15 m^2 cross-sectional area. The air is heated through a turbine, and exhausted area at 0.18 MPa, 150°C through an opening of 0.10 m^2 cross-sectional. The power output is 375 kW. Calculate the net amount of heat added to the air in kJ/kg. **(10)**

2. 100 kilograms per hour of water runs through a heat exchanger, entering as saturated liquid at 300 kPa and leaving as mixture of water and vapor with quality of 0.85. The heat is supplied by a Carnot heat pump operating from a low-temperature reservoir at 20°C. Find the rate of work into the heat pump. **(10)**

3. A piston cylinder setup with a constant pressure has 0.75 kg saturated vapor water at 200 kPa. It is now cooled so the volume becomes half the initial volume by heat transfer to the ambient at 20°C. Find the work, the heat transfer and the total entropy generation **(12)**

4a. Is the value of the $\int_1^2 \frac{\delta Q}{T}$ same for all reversible process? Justify **(4)**

4b. Simplify the steady state steady flow energy equation for the following cases
(i) Nozzle with inlet velocity is much less than the exit velocity (ii) Heat exchanger
(ii) Adiabatic flow in Diffuser (iv) Compressor **(4)**

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BITS, PILANI DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY

FIRST SEMESTER 2011-12

COURSE: BITS F111 Thermodynamics

Test I (Closed Book)

Max. Marks: 50 **Date: 9.10.11**

Weightage : 25% **Time: 50 min**

Note: Answer all the Questions and Assume suitable value if required

1. At the bottom of a15m tall cylinder is liquid water to a height of 6 m. On top of which is a 4m high layer of oil with specific gravity of 0.85.The gasoline surface is exposed to atmospheric air at 101kPa.What is the highest pressure in the water? **(5)**

2. A piston-cylinder device contains 0.1 m^3 of liquid water and 0.9m^3 water vapour in equilibrium at 800 kPa .Heat is transferred at constant pressure until the temperature reaches 350°C. **(a)** What is the initial temperature of the water? **(b)**Determine the total mass of water, **(c)** Calculate the final volume **(d)** show the process on a P-v diagram**(12)**

3. A 1 m^3 container is filled with 400 kg of granite stone, 200 kg dry sand and 0.2 m^3 of liquid 25°C water. Use properties from tables A.3 and A.4 and use air density of 1.1 kg/m^3. Find the average specific volume and density of the 1 m^3 volume. **(6)**

4. A rigid tank of volume 0.5 m^3 contains 80 per cent by volume of saturated liquid water and 20 per cent by volume of saturated steam at 200 °C. Now 140 kg of liquid water is pumped into the tank. If the final temperature of the fluid in the tank is 80°C, determine the final pressure. **(10)**

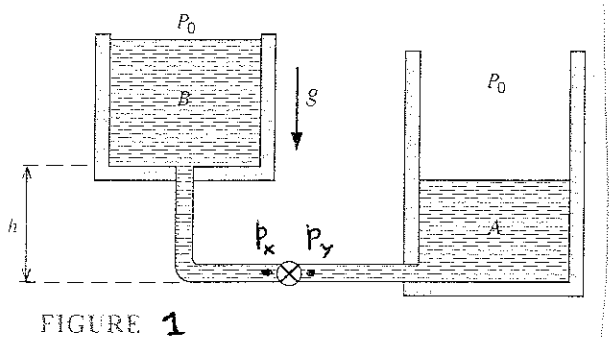

FIGURE 1

5. Two cylinders are filled with liquid water, ρ = 1000 kg/m^3, and connected by a line with a closed valve as shown in fig.1. A has 100 kg and B has 500 kg of water, their cross-sectional areas are A_A= 0.1 m^2 and A_B = 0.25 m^2 and the height h is 1 m. Find the pressure on each side of the valve. The valve is opened and water flows to an equilibrium. Find the final pressure at the valve location. Assume P_o = 101.325 kPa **(12)**

6. A cylindrical gas tank 1 m long, inside diameter of 20 cm, is evacuated and then filled with carbon dioxide gas at 25°C. To what pressure should it be charged if there should be 1.2 kg of carbon dioxide? **(5)**

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BITS, PILANI – DUBAI CAMPUS
FIRST SEMESTER 2011 – 2012
First Year Sections 2, 4 & 6

Quiz 2 **A**

Course Code: BITS F111 / ES C112 Date: 21. 11 .11 **Name:**----------

Course Title: THERMODYNAMICS Max Marks: 14 **ID.No:**----------

Duration: 20minutes Weightage: 7% **Sec.:** ----------

Instructions: 1. Attempt all questions 2.Assume suitable value if required

1. An ideal gas in a piston is heated with 2 kJ during an isothermal process. How much work is involved? **(2)**

2. A 3 m^3 rigid tank contains nitrogen gas at 500 kPa and 300 K. Heat is transferred to the nitrogen in the tank and the pressure of nitrogen rises to 800 kPa. What is the work done during this process? **(2)**

3. An egg with a mass of 0.1kg and a specific heat of 3.32 kJ/kg °C is cooled from 22° C to 5° C.What is the heat transferred from the egg? **(2)**

4. In a P-v diagram ,represent a constant pressure expansion of a gas **(2)**

5. 1.5 kg of liquid having a constant specific heat of 2.5 kJ/ kg. K is stirred in a well-insulated chamber causing the temperature to rise by 15°C. Find ΔE for the process. **(2)**

6. The heat transferred into a closed system during a process is 3000 kJ. If the work done by the system is 1600 kJ, determine the change in total energy of the system. **(2)**

7. The mass of a car with passengers is 2000 kg. What is the minimum power rating required to accelerate the car from rest to a speed of 90 kmph? **(2)**

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BITS, PILANI – DUBAI CAMPUS
FIRST SEMESTER 2011 – 2012
First Year Sections 2, 4 & 6

Quiz 1 **A**

Course Code: BITS F111 /ESC 112	Date: 24. 10 .11	**Name:**----------
Course Title: THERMODYNAMICS	Max Marks: 16	**ID.No:**----------
Duration: 20minutes	Weightage: 8%	**Sec.:** ----------

Instructions: ***1. Attempt all questions*** ***2.Assume suitable value if required***

1. *Name the 3 heat transfer modes* ***(3)****.*

2. *The rolling resistance of a car depends on its weight as* $F=0.005\, m_{car} g$*. what is the mass of the car if it drives for 5m for a work input of 25 kJ* ***(3)***

3. In a piston/cylinder arrangement, 2 kg of saturated vapor with a volume of 2 m^3 is expanded to the volume of 4 m^3, when heat is added at constant pressure process with a pressure of 500 kPa. Find the specific work done.**(2)**

4. Define the term: Polytropic Process and Isobaric Process**(2)**

5. Helium gas expands from 125 kPa, 350 K and 0.25 m^3 to 100 kPa in a polytropic process with n = 1.667. How much work does it give out? **(3)**

6. A 2 m^2 window has a surface temperature of 15°C and the outside wind is blowing air at 2°C across it with a convection heat transfer coefficient of h = 125 W/m^2K. What is the total heat transfer loss? (3)

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