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

Course: BITS F111 Thermodynamics

Comprehensive Examination [Closed Book]

Max.Marks:80 **Date: 7-6-2012**
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 Data book is permitted (iv) Answer Every Question on a fresh page
*(v) Answer the questions of **Part A and Part B separately***

PART A

1. (a) The main waterline into a tall building has a pressure of 600 kPa at 5m elevation below ground level. How much extra pressure does a pump need to add to ensure a water line pressure of 200 kPa at the top floor 150m above ground? **(5)**

   (b) A cylindrical gas tank 2 m long, with inside diameter of 30 cm , is evacuated and then filled with carbon dioxide gas at 25^{0}C. To what pressure should it be charged if there should be 2.5 kg of carbon dioxide? **(5)**

2. A nozzle receives 0.2 kg/s of steam at 3 MPa and 600^{0}C with negligible kinetic energy. The exit is at 1500 kPa and 400^{0}C, and the flow is adiabatic. Find the nozzle exit velocity and the exit area. **(10)**

3. A cylinder having an initial volume of 3 m^3 contains 0.1 kg of water at 40^{0}C. The water is then compressed in an isothermal quasi-equilibrium process until it has a quality of 50%. Calculate the work done by splitting the process into two steps. Assume the water vapor is an ideal gas during the first step of the process. **(10)**

4. A rigid container has 1.5 kg of water at 500^{0}C, 1500 kPa. The water is now cooled to a final pressure of 600 kPa. Find the final temperature, the work, and the heat transfer in the process. **(10)**

PART-B

1. A steel bottle of V = 0.1 m^3 contains R-134a at 20°C, 200 kPa. It is placed in a deep freezer where it is cooled to -20°C. The deep freezer sits in a room with ambient temperature of 20°C and has an inside temperature of -20°C. Find the amount of energy the freezer must remove from the R-134a and the extra amount of work input to the freezer to do the process. **(10)**

2. One kilogram of water at 300°C expands against a piston in a cylinder until it reaches ambient pressure, 100 kPa, at which point the water has a quality of 90.2%. It may be assumed that the expansion is reversible and adiabatic. What was the initial pressure in the cylinder and how much work is done by the water? **(10)**

3. A small turbine delivers 150 kW and is supplied with steam at 700°C, 2 MPa. The exhaust passes through a heat exchanger where the pressure is 10 kPa and exits as saturated liquid. The turbine is reversible and adiabatic. Find the specific turbine work, and the rate of heat transfer in the heat exchanger. **(10)**

4. A 2 kg/s flow of steam at 1 MPa, 700°C should be brought to 500°C by spraying in liquid water at 1 MPa, 20°C in a steady flow. Find the entropy of generation and the rate of irreversibility, assuming that surroundings are at 20°C. **(10)**

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SECOND SEMESTER 2011-12

COURSE: BITS F111 Thermodynamics

Test 2 (Open Book)

Max. Marks: 40 **Date: 26.04.12**

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

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

1. A piston/cylinder arrangement contains water of quality x = 0.7 in the initial volume of 0.1 m^3, where the piston applies a constant pressure of 200kPa. The system is now heated to a final temperature of 200^{0}C. Determine the work and the heat transfer in the process. **(10)**

2. A piston/ cylinder arrangement of initial volume 0.025 m^3 contains saturated water vapor at 180^{0}C. The steam now expands in a polytropic process with exponent n = 1 to a final pressure of 200kPa while it does work against the piston. Determine the heat transfer for this process. **(10)**

3. a) How power is produced in a turbine? **(5)**

   b) R-410a at 50 k Pa and -40°C enters a compressor and exits it at 500 k Pa and 20°C. Find the rate of heat transfer from the compressor if the power input is 18kW and the mass flow rate is 0.4kg/s. **(5)**

4. Ammonia enters a nozzle at 1000kPa and 120°C with a low velocity at a steady rate of 0.05 kg/s. The ammonia exits at 400kpa with a velocity of 500m/s. If the heat loss during the process is 10kW, determine the exit temperature and exit area of the nozzle. **(10)**

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BITS, PILANI DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY

SECOND SEMESTER 2011-12

COURSE: BITS F111 Thermodynamics

Test I (Closed Book)

Max. Marks: 50 **Date: 11.03.12**

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

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

1. 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. Find the average specific volume and density of the masses when you exclude air mass and volume. **(10M)**

2. Two vertical cylindrical storage tanks are full of liquid water with the top open to the atmosphere. One is 10 m tall and 2 m in diameter, the other is 2.5 m tall with diameter 4 m. What is the total force from the bottom of each tank to the water and what is the pressure at the bottom of each tank? **(15M)**

3. Determine the temperature of nitrogen at 3MPa with a specific volume of 0.0249m^3/kg. Indicate the relative position of the given state in a P-T, T-v and P-v diagram. **(10M)**

4. 0.75 kg of R-134a fills a 0.1450m^3 rigid container at an initial temperature of -40°C. The container is then heated until the pressure is 150 kPa. Determine the initial pressure, final temperature and also indicate the process in a T-v diagram. **(15M)**

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BITS, PILANI – DUBAI CAMPUS
SECOND SEMESTER 2011 – 2012

First Year Sections 1, 3 & 5

Quiz 2 **A**

Course Code: BITS F111	Date: 23. 05 .12	**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 air conditioner discards 5.1kW to the ambient surroundings with a power input of 1.5kW.Find the rate of cooling and the Coefficient of performance. **(3M)**

2. Calculate the thermal efficiency of a Carnot-cycle heat engine operating between reservoirs at 300^0C and 45^0C. **(2M)**

3. A heat pump is used to maintain a temperature of 4°C in a refrigerator when it rejects the heat at 27°C.Determine the COP of the heat pump. **(2M)**

4. An automobile engine produces 100 HP on the output shaft with a thermal efficiency of 20%. The fuel that burns gives 25,000 kJ/kg as energy release. Find the rate of fuel consumption in kg/s. (1HP=0.735 kW) **(3M)**

5. Heat is transferred to heat engine from furnace at a rate of 60 MW. If the rate of waste heat rejection to cold body is 40 MW determine the net power output for the heat engine. **(2M)**

6.A Carnot engine receives 300 kJ heat from high temperature source at 500°C and rejects heat to a low temperature sink at 25°C.Determine the amount of heat rejected to sink. **(2M)**

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BITS PILANI , DUBAI CAMPUS
SECOND SEMESTER 2011 – 2012

First Year Sections 1, 3 & 5

Quiz 1

A

Course Code: BITS F111	Date: 4. 4 .12	**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. A piston –cylinder device containing CO_2 undergoes an isobaric process from 20°C to 100 °C. Determine the specific work done during the process at a pressure of 800 kPa, if the specific gas constant for CO_2 is 0.2kJ/kg K **(3)**

2. A tank containing nitrogen at an initial pressure of 600kPa is compressed isothermally from 0.8 m^3 to 0.1 m^3.Find the work done during the process **(3)**

3. A log of burning wood in the fire place has a surface temperature of 400°C.Assume that the emissivity is 1 find the radiant emission of energy per unit surface area ($\sigma = 5.67\times10^{-8}$ W m^{-2} K^{-4}) **(2)**

4. Differentiate heat from work **(2)**

5. A 2 m^2 window has a surface temperature of 10°C and the outside wind is blowing air at 4°C across it with a convection heat transfer coefficient of h=125 W/m2 K. What is the total heat transfer loss?**(2)**

6. Ammonia in a cylinder is heated from 190 kPa to 500 kPa during which time the volume increased by 1.4 times. Represent this process in a P-v diagram**(2)**

7. A linear spring $F=K(x-x_0)$ with k=500 Nm^{-1} is stretched until it is 100mm longer. Find the required force?**(2)**

x----------x

BITS PILANI , DUBAI CAMPUS
SECOND SEMESTER 2011 – 2012
First Year Sections 1, 3 & 5

Quiz 1 **B**

Course Code: BITS F111	Date: 4. 4 .12	**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. A linear spring $F=K\ (x-x_0)$ with $k=500\ Nm^{-1}$ is stretched until it is 100mm longer. Find the required force?**(2)**

2. Ammonia in a cylinder is heated from 190 kPa to 500 kPa during which time the volume increased by 1.4 times. Represent this process in a P-v diagram**(2)**

3. A 2 m^2 window has a surface temperature of 10°C and the outside wind is blowing air at 4°C across it with a convection heat transfer coefficient of h=125 W/m2 K. What is the total heat transfer loss?**(2)**

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7. A piston –cylinder device containing CO_2 undergoes an isobaric process from 20°C to 100 °C. Determine the specific work done during the process at a pressure of 800 kPa, if the specific gas constant for CO_2 is 0.2kJ/kg K **(3)**

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