BITS, PILANI – DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

I Year II Semester -2008-2009

Course: ES C112 Thermodynamics

COMPREHENSIVE EXAMINATION [CLOSED BOOK]

Max.Marks: 80 **Date: 27-05-2009**

Weightage: 40 % **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

PART A

1. Two piston/cylinder arrangements, A and B, have their gas chambers connected by a pipe. Cross-sectional areas are A= 75 cm^2 and AB = 25 cm^2 with the piston mass in A being m_A = 25 kg. Outside pressure is 100 kPa and standard gravitation. Find the ***mass m_B*** so that none of the pistons have to rest on the bottom A **[6M]**

2.[A] Draw ***P-T diagram*** for a substance that expands on freezing:- **[4M]**

[B]. Saturated water vapor at 200 kPa is in a constant pressure piston cylinder. At this state the piston is 0.1 m from the cylinder bottom. How much is this distance and the temperature if the water is heated to occupy twice the original volume? **[5M]**

3.[A] Derive an equation of ***Work done*** for a Polytropic Process:- **[4M]**

[B]. Due to a faulty door contact the small light bulb (25 W) inside a refrigerator is kept on and limited insulation lets 50 W of energy from the outside seep into the refrigerated space. How much of a ***temperature difference*** to the ambient at 20°C must the refrigerator have in its heat exchanger with an area of 1 m^2 and an average heat transfer coefficient of 15 W/m^2 K to reject the leaks of energy? **[5M]**

4. Water at 150°C, quality 50% is contained in a cylinder/piston arrangement with initial volume 0.05 m^3. The loading of the piston is such that the inside pressure is linear with the square root of volume as $P = 100 + CV^{0.5}$ kPa. Now heat is transferred to the cylinder to a final pressure of 600 kPa. Find the ***heat transfer*** in the process. **[6M]**

5.[A]. What is the difference between a ***nozzle*** flow and a ***throttle*** process? **[4M]**

[B]. A steam turbine receives water at 15 MPa, 600°C at a rate of 100 kg/s, shown in Fig.1. In the middle section 20 kg/s is withdrawn at 2 MPa, 350°C, and the rest exits the turbine at 75 kPa, and 95% quality. Assuming no heat transfer and no changes in kinetic energy, find the total turbine ***power output***. **[6M]**

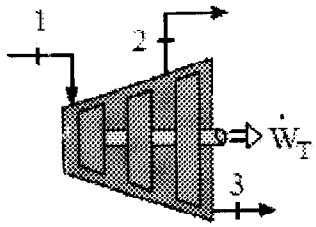

Fig.1

PART B

1. Refrigerant-12 at 95°C, x = 0.1 flowing at 2 kg/s is brought to saturated vapor in a constant-pressure heat exchanger as shown in Fig 2. The energy is supplied by a heat pump with a coefficient of performance of $\beta' = 2.5$. Find the required ***power*** to drive the heat pump. **[7M]**

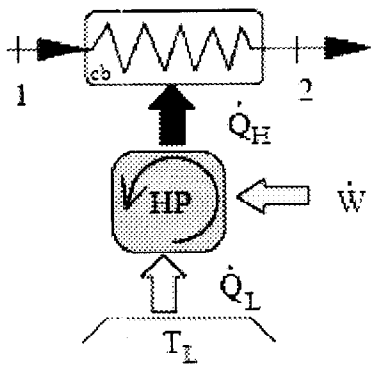

FIG 2

2. A piston cylinder loaded so it gives 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 ***entropy generation***. **[7M]**

3. A small turbine is operated 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 as shown in Fig.3. The turbine is reversible and adiabatic. Assume the isentropic turbine efficiency is 88 %. Find the actual specific ***turbine work*** and the specific ***heat transfer*** in the heat exchanger. **[7M]**

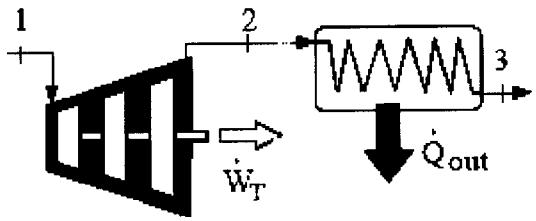

FIG.3

4.[A] Explain detail about the concept of available and unavailable energy with neat sketch. **[4M]**

[B].Derive an expression for reversible and irreversible process in real steady state process and explain with neat sketch. **[4M]**

5. [A] State 'Dalton's law of partial pressure. **[3M]**

[B]. Define the following terms: **[4M]**

1) Dry bulb temperature
2) Dew point temperature
3) Relative humidity
4) Specific Humidity

[C]. Explain briefly with a neat sketch a 'Psychrometer'. **[4M]**

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Dubai International Academic City, Dubai, U.A.E

I Year II Semester 2008-2009

Test No.2 (Open Book)

Course No. ES C112 **Course Title:** Thermodynamics

Date: 12-04-2009 **Max.Marks:** 20 **Weightage:** 20 **Duration:** 50 min.

Notes:

- Answer all the questions
- Draw neat sketches wherever necessary
- Thermodynamics Tables are permitted.
- Make suitable assumptions if required and clearly state them

Q1. A container is divided into two compartments by partition. The container is completely insulated so that there is no heat transfer. One portion contains gas at temperature T_1 and pressure P_1 while the other portion also has the same gas but at temperature T_2 and pressure P_2.

How will the ***First Law Thermodynamics*** conclude the result if partition is removed? **[2M]**

Q2. In a system, executing a non flow process, the work and heat per degree of change of temperature are given by

$$\frac{dW}{dT} = 200\ \mathrm{J}/^{0}C \qquad \text{and} \quad \frac{\mathrm{dQ}}{\mathrm{dT}} = 160\ \mathrm{J}/^{0}C$$

What will be the ***change of internal energy*** of the system when its temperature changes from **55^{0}C** to **95^{0}C** ? **[3M]**

Q3. On a hot summer day, a student turns his fans on when he leaves his room in the morning. When he returns in the evening, will the room be warmer or cooler then the neighboring rooms? Why? Assume all the doors and windows are kept closed. **[2M]**

Q4. Air at **101.325 KPa, 20^{0}C** is taken into a gas turbine power plant at a velocity of **140m/s** through opening of cross-sectional area at inlet is **0.15 m^2** as shown in **Fig.1**. The air is compressed, heated, expanded through a turbine and exhausted pressure at **0.18 MPa, 150^{0}C** through an opening of cross-sectional area at outlet is **0.10 m^2**. The power output of the turbine is **375kW**. Calculate the net amount of heat added to the air in kJ/kg. Assume that air obeys the

law **Pv = 0.287 (t+273),** where **'P'** is the pressure in KPa, **'v'** is the specific volume in m^3/kg, **'t'** is the temperature in °C. Take C_p **= 1.005 kJ/kg.K.** **[7M]**

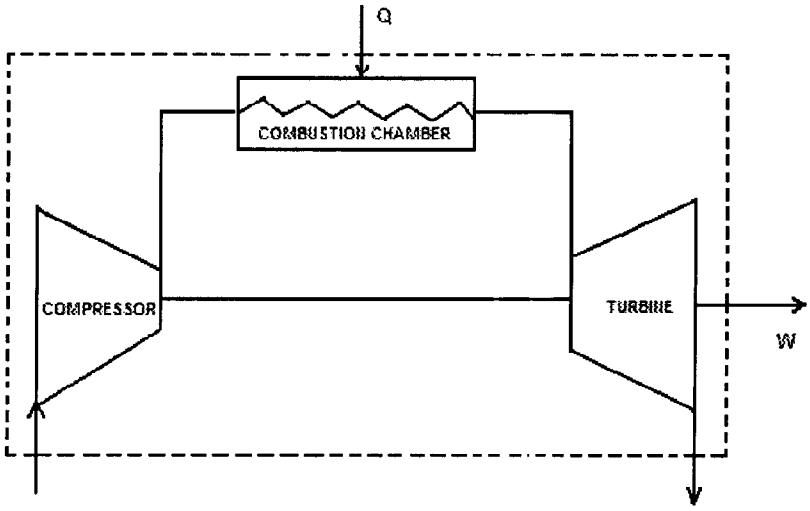

FIG.1

Q5. 1kW power can be developed from heat engine, which is used to drive a heat pump as shown in **Fig.2.** The heat transfers from the heat engine and from heat pump are used to heat the water circulating through the radiators of a building. The efficiency of the heat engine is **27 %** and **COP** of the heat pump is **4**. Evaluate the ratio of the total heat transfer to the building to the heat transfer to the heat engine. Also calculate heat input to heat pump. **[6M]**

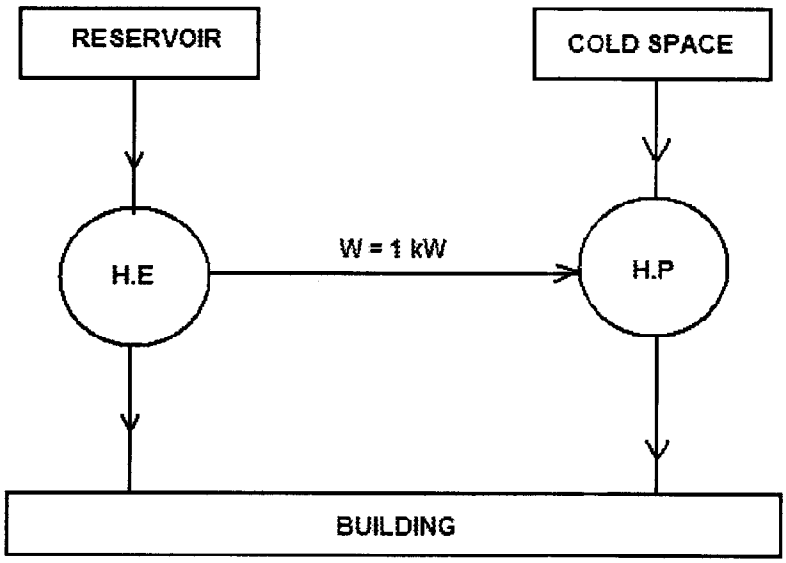

FIG.2

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I Year II Semester 2008-2009

Test No.1 (Closed Book)

Course No. ES C112 **Course Title:** Thermodynamics

Date: 01-03-2009 **Max.Marks:** 25 **Weightage:** 25%

Duration: 50 min.

Notes:

- Answer all the questions
- Draw neat sketches wherever necessary
- Thermodynamics Tables are permitted.
- Make suitable assumptions if required and clearly state them

Q 1 A. Define '***Zeroth Law*** of Thermodynamics' **[3M]**

B. When you move up from the surface of the earth, the gravitation is reduced as $g = 9.807 - 3.32 \times 10^{-6}\ \mathbf{z}$ where **z** is the elevation in meters. By how many percent is the weight of an air plane reduced when it cruises at 11000m ? **[5M]**

Q 2.A. Define ***generalized compressibility*** chart:- **[3M]**

B. Water at 120°C with a quality of 25% has its temperature raised 20°C in a constant volume process. What is the new quality and pressure? **[5M]**

Q.3.A. Prove that ***Work done*** is a path function:- **[4M]**

B. A piston/cylinder has 5 m of liquid 20°C water on top of the piston with cross-sectional area of 0.1 m^2, as shown in Fig.1. Air is let in under the piston that rises and pushes the water out over the top edge. Find the necessary work to push all the water out and plot the process in a P-V diagram. Assume that the mass of the piston and thickness is negligible. Take atmospheric pressure p_o = 101.32 kPa, density of water is 997 kg/m^3 and g = 9.807 kg/m^2. **[5M]**

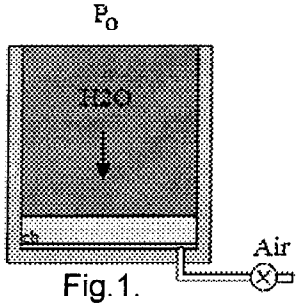

Fig.1.

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I YEAR II SEMESTER 2008-2009

A

THERMODYNAMICS ES C112

QUIZ -3

DURATION: 15 MINUTES **MAXIMUM MARKS:** 10 **DATE :** 28/04/09

Note :

1) Answer only in the sheet provided
2) Put √ across the correct answer for multiple choice Questions
3) Do not scribe or overwrite
4) Write Name, I D No. on the answer
5) Return the answer sheet

Name : ---------- **I.D No.** ---------- **SECTION** ---------VIII

1. An Heat Engine having ***100%*** Efficiency is called ----------
2. The net area in a T-S diagram represents ----------
3. The COP of refrigerator which has a refrigeration capacity of 1500 KJ/hr when the power input is 0.20 KW is ----------
4. The equation for ***Isentropic efficiency*** for a turbine can be written as

$$\eta_{Turbine} =$$

5. For any ***irreversible*** process the net ***entropy*** change is ----------
6. ***Reversible adiabatic*** flow process is called ----------
7. If the temperature of the ***source*** is increased, the ***efficiency*** of the Carnot engine ----------
8. ***Kevin plank's*** Statement for second law deals with ----------
9. $(\Delta S)_{irreversible} = \frac{dQ}{T} +$ -------
10. The equation for first law for a process in terms of ***entropy*** is ----------

Sec. VIII

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I YEAR II SEMESTER 2008-2009

THERMODYNAMICS ES C112

QUIZ -2

DURATION: 15 MINUTES **MAXIMUM MARKS:** 10 **DATE :** 24/03/09.

Note :

1) Answer only in the sheet provided
2) Put √ across the correct answer for multiple choice Questions
3) Do not scribe or overwrite
4) Write Name, I D No. on the answer
5) Return the answer sheet

Name : ---------- **I.D No.** ----------

1. The difference between two specific heats Cp & Cv is ----------
2. The heat transfer in a constant-volume quasi equilibrium process is equal to -----
3. An example of a power producing device is ----------
4. An example of power consuming device is ----------
5. An example of a Heat Exchanger is ----------
6. The function of a throttle valve is ---------- the flow.
7. The processes that do not involve heat is called ---------- processes.
8. The mathematical equation for continuity equation is ----------
9. A device used to decelerate a high velocity fluid is ----------
10. 1.5 kg. of liquid having a constant sp.heat of 2.5 kJ/kg^{0}C is stirred in a well insulated Chamber causing the temperature to rise by 15^{0}C , Change in Internal energy is --------

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SECOND SEMESTER 2008-2009

THERMODYNAMICS ES C112

[FIRST YEAR SECTION VIII]

QUIZ -1

DURATION: 15 MINUTES **MAXIMUM MARKS:** 10 **DATE :**

Note :

1) Answer only in the sheet provided
2) Put √ across the correct answer for multiple choice Questions
3). Do not scribe or overwrite
4) Write Name, I D No. on the answer
5) Return the answer sheet

Name : ---------- **I.D No.** ----------

1. Which process is said to be ***isochoric*** process
a) Heating water in the open vessel **b**. Heating of a gas filled in a closed vessel
c. Melting of ice **d**. Expansion of steam in an insulated nozzle **e**. None of the above

2. The governing equation fort a ***polytropic*** process is ----------

3. All the thermodynamic ***properties*** are.....
a) In-exact differential **b**. Exact differential **c**. Both **d.** none of the above

4. Which process is called as ***adiabatic*** process
a) Heating water in the open vessel **b**. Heating of a gas filled in a closed vessel
c. Melting of ice **d**. Expansion of steam in an insulated nozzle **e**. None of the above

5. ---------- = *Patm – Pvac*

6. Absolute temperature scale for ***Celsius scale*** is ----------

7. Heat transferred ----------a system is ***POSITIVE***

8. ---------- approach is used in ***Classical*** Thermodynamics

9. For saturated liquid the value of **x** , the dryness fraction is ----------

10. The relationship between the universal gas constant $\overline{R}$ and characteristic gas constant **R** is ----------

Sec · 6

BITS, PILANI-DUBAI
INTERNATIONAL ACADEMIC CITY, DUBAI
I YEAR II SEMESTER 2008-2009

THERMODYNAMICS ES C112

A

QUIZ -3

DURATION: 15 MINUTES **MAXIMUM MARKS:** 10 **DATE :** 28/04/09

Note :

1) Answer only in the sheet provided
2) Put √ across the correct answer for multiple choice Questions
3) Do not scribe or overwrite
4) Write Name, I D No. on the answer
5) Return the answer sheet

Name : ---------- **I.D No.** ---------- **SECTION** ---VI

1. The area under a curve in T-S Diagram represents ----------
2. ***Clausius*** Statement for second law deals with ----------
3. The equation for ***Isentropic efficiency*** for a turbine can be written as

$\eta_{compressor}$ =

4. The shape of the Carnot cycle in a T-S Diagram is ----------
5. Concept of Second law of Thermodynamics is ----------
6. The equation for ***Clausius Inequality*** is ----------
7. The COP of Heat pump which has a refrigeration capacity of 1500 KJ/hr when the power input is 0.30 KW is ----------
8. Main cause for ***irreversibility*** is ---------- and ----------
9. If the temperature of the ***sink*** is increased, the ***efficiency*** of the Carnot engine ----------
10. The measure of the order of the disorder of the molecule is called ----------

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I YEAR II SEMESTER 2008-2009

THERMODYNAMICS ES C112

Section VI

QUIZ -2

DURATION: 15 MINUTES **MAXIMUM MARKS:** 10 **DATE :** 24/13/08

Note :

1) Answer only in the sheet provided
2) Put √ across the correct answer for multiple choice Questions
3) Do not scribe or overwrite
4) Write Name, I D No. on the answer
5) Return the answer sheet

Name : ---------- **I.D No.** ----------

1. First law of thermodynamics does not deals with.....
   a) amount of energy converted from one form of energy to another form of energy
   b) Direction of flow of energy
   c) Both
   d) None of the above
2. Which is not the assumption in steady-state flow process?
   a) The state of the mass at each point in the control volume does not vary with time
   b) The control volume does not more relative for the co-ordinate frame
   c) As for the mass flow across the control surface, the mass flux and the state of this mass at each discrete area of flow on the control surface do not vary with time
   d) The state of the mass within the control volume may change with time.
3. If all the variables of a stream are independent of time it is said to be in ----------
4. Internal energy of a perfect gas depends on --------
5. In S.I units, the value of the universal gas constant is ----------
6. The basic statement of First law of thermodynamics is given by the equation ------
7. The heat transfer in a constant-pressure quasi equilibrium process is equal to -----
8. A tank containing a fluid is stirred by a paddle wheel. The work input to the paddle wheel is 5090 KJ. The heat transfer from the tank is 1500 KJ. Consider the tank and the fluid inside a control surface. The change in internal energy of this control mass is ----------
9. An example of a Prime mover is ----------
10. In throttling processes ---------- remains constant

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INTERNATIONAL ACADEMIC CITY, DUBAI

SECOND SEMESTER 2008-2009

THERMODYNAMICS ES C112

[FIRST YEAR SECTION VI]

QUIZ -1

DURATION: 15 MINUTES **MAXIMUM MARKS:** 10 **DATE :** 24/02/09.

Note :

1) Answer only in the sheet provided
2) Put √ across the correct answer for multiple choice Questions
3) Do not scribe or overwrite
4) Write Name, I D No. on the answer
5) Return the answer sheet

Name : ---------- **I.D No.** ----------

1. Which is not a thermodynamic ***property***.....
   a. Temperature **b**. Pressure **c**. Volume **d**. Heat **e**. None of the above

2. First law of thermodynamics gives the **concept** of .....
   a) Entropy **b**. Energy **c.** Both **d**. none of the above

3. In which process, ***work done*** will be zero.
   a. Isothermal Process **b**. Adiabatic process **c**. Isochoric Process
   d. Isobaric Process **e**. none of the above

4. Which process is said to be ***isothermal*** process.....
   a. Heating of water in the open vessel. **b**. Heating of a gas filled in a closed vessel.
   c. Melting of an ice **d.** Expansion of steam in the nozzles

5. The ***third law*** of thermodynamics is formulated by ---------- in -------- year

6. ---------- approach is used in ***Statistica***l Thermodynamics.

7. $P_{absolute}$ = ---------- + P_{gauge}

8. Absolute temperature scale for ***Fahrenheit*** Scales is ----------

9. Heat transferred ----------a system is ***NEGATIVE***

10. Example for a ***boundary*** phenomenon is ----------

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Dubai International Academic City, Dubai
2nd Sem IV Sec 2008-09

Subject: Thermodynamics
Course No: ES C 112

DATE: 23/ 04 / 09
Duration: 15 Min **Max. Marks: 5**

Name of the student: ---------- I.D.: ----------

QUIZ III - QUESTIONS

Qa	1	2	3	4	5	6	7	8	9	10
Ans										

[1] When there is some restriction to the flow is called

[a] Diffusers [b] Venturi effect [c] Throttling [d] Nozzle

[2] A hydraulic hoist raises a 1750 kg car 1.8 m in an auto repair shop. The hydraulic pump has a constant pressure of 800 kPa on its piston. How much volume should the pump displace to deliver that amount of work?

[a] 0.03 m^3 [b] 0.04 m^3 [c] 0.02 m^3 [d] 0.05 m^3

[3] A refrigerator operating on reversible cycle is pumping heat from – 5 ^{0} C space to the atmosphere at 40 ^{0} C. Find COP.

[a] 6.9 [b] 5.9 [c] 4.9 [d] 7.9

[4] A control volume refers to

[a] A fixed region in space [b] A specified mass
[c] A closed system [d] An isolated system

[5] A 1200 kg car accelerates from zero to 100 km/h over a distance of 400 m. The road at the end of the 400 m is at 10 m higher elevation. What is the total increase in the car kinetic and potential energy?

[a] 116 kJ [b] 119 kJ [c] 120 kJ [d] 117 kJ

[6] During throttling process

[a] Internal energy does not change [b] Pressure does not change
[c]Entropy does not change [d]Enthalpy does not change

[7] A piston/cylinder contains 0.001 m^3 air at 300 K, 150 kPa. The air is now compressed in a process in which $P V^{1.25} = C$ to a final pressure of 600 kPa. Find the final air temperature.

[a] 393 K [b] 396 K [c] 397 K [d] 392 K

[8] Oxygen at 300 kPa, 100°C is in a piston/cylinder arrangement with a volume of 0.1 m^3. It is now compressed in a polytropic process with exponent, n = 1.2, to a final temperature of 200°C. Calculate the work done for the process.

[a] 40 kJ [b] 42 kJ [c] - 40 kJ [d] - 42 kJ

[9] A piston cylinder contains 0.1 kg air at 300 K and 100 kPa. The air is now slowly compressed in an isothermal (T = C) process to a final pressure of 250 kPa. Show find out the work in the process.

[a] 7.89 kJ [b] – 8.89 kJ [c] -7.89 kJ [d] 8.89 kJ

[10] A refrigerator of COP 3 is to pump 54,000 kJ /hr of heat from a cold space into the atmosphere. What is the power required to run the refrigerator.

[a] 6 kW [b] 7 kW [c] 4 kW [d] 5 kW

**********a

BITS, PILANI-DUBAI CAMPUS, ACADEMIC CITY, DUBAI
I st Year, 2nd Sem IV Sec 2008-09

Subject: ES C 112 Thermodynamics

DATE: / / 08...

Duration: 15 Min **Max. Marks: 5**

Name of the student: ---------- I.D.: ----------

QUIZ II - QUESTIONS

aQ	1	2	3	4	5	6	7	8	9	10
Ans										

[1] Enthalpy is equal to

[a] Internal Energy + Flow Energy [b] Internal Energy + Total Energy
[c] Potential Energy + Flow Energy [d] Kinetic Energy + Flow Energy

[2] 5 kg of air at 40 ^{0}C and 1 bar is heated in a reversible non-flow constant pressure until the volume is doubled. Find the work done.

[a] 450 kJ [b] 447 kJ [c] 449 kJ [d] 448 KJ

[a] 4.2 kJ [b] – 3.2 kJ [c] – 4.2 kJ [d] 3.2 kJ

[3] One kg of ideal gas is heated from 18 ^{0}C to 93 ^{0}C. Assume R = 264 J/kg k, Ratio of specific heats 1.18 for the gas. Find the value of specific heat at constant pressure (Cp).

[a] 1.9 kJ/kg k [b] 1.5 kJ/kg k [c] 2.1 kJ/kg k [d] 1.7 kJ/kg k

[4] In an I.C.Engine during compression stroke, the heat rejected to the cooling water is 50 kJ/kg and the work input is 100 kJ/kg. Find the I.E.

[a] 50 kJ/kg [b] 54 kJ/kg [c] 52 kJ/kg [d] 49 kJ/kg

[5] The ratio of specific heats

[a] $\gamma = C_v / C_p$ [b] $\gamma = C_p / C_v$ [c] $\gamma = C_p / C_t$ [d] $\gamma = C_p / C_\rho$

[6] A liquid of mass 18 kg is heated from 25 ^{0} C. to 85 ^{0} C. How much heat is required? Assume Cp for water is 4.2 kJ / kg.k.

[a] 4539 kW [b] 4533 kW [c] 4536 kW [d] 4530 kW

[7] A mercury (Hg) manometer is used to measure the pressure in a vessel. The mercury has density of 13590 kg / m^3 and gaguge pressure is 31985 Pa. Find the height difference between the two columns.

[a] 0.3299 [b] 0.2399 [c] 0.4999 [d] 0.5399

[8] A vessel contains 3.0 kg of liquid water and vapour mixture in equilibrium at quality of 53 %. Find the mass of Liquid.

[a] 1.4 kg [b] 4.1 kg [c] 2.4 kg [d] 3.1 kg

[9] What is the volume of air having the mass of 280 kg, if the pressure is 100 kPa and the temperature is 298 K.

[a] 242 m^3 [b] 241 m^3 [c] 237 m^3 [d] 239 m^3

[10] Reversible constant pressure is

[a] Isochoric process [b] Adiabatic process
[c] Polytropic process [d] Isobaric process

**********a

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai
II Sem IV Sec 2008-09

Subject: Thermodynamics
Course No: aES C 112

QUIZ I

DATE: / /09

Duration: 15 Min **Max. Marks: 5**

Name of the student: ---------- I.D.: ----------

Q	1	2	3	4	5	6	7	8	9	10
Ans										

1. The unit of force is the Newton (N), which is equal to

[a] 1 kg m/ s^2 [b] 1 kg m^2/ s [c] 1 kg m/ s [d] 1 kg m^2/ s^2

2 One bar is equal to

[a] 1000 kPa [b] 100 MPa [c] 0.1 MPa [d] 10^6 Pa

3. A liquid of mass 18 kg is heated from 25 ^{0} C. to 85 ^{0} C. How much heat is required? Assume Cp for water is 4.2 kJ / kg.k.

[a] 4539 kW [b] 4533 kW [c] 4536 kW [d] 4530 Kw

4. What is the weight of a one kg mass at an altitude where the local acceleration of gravity is 9.75 m / s^2 ?

[a] 9.85 N [b] 9.75 N [c] 9.57 N [d] 9.95 N

5. A 1-m^3 container is filled with 0.12 m^3 of granite with density of 2750 kg / m^3 and also filled with 0.15 m^3 of sand with density of 1500 kg / m^3. Find the overall specific volume.

[a] 1.8 X 10^{-3} kg / m^3 [b] 1.9 X 10^{-3} kg / m^3 [c] 1.7 X 10^{-3} kg / m^3
[d] 2.0 X 10^{-3} kg / m^3

6. A mercury (Hg) manometer is used to measure the pressure in a vessel. The mercury has density of 13590 kg / m^3 and gaguge pressure is 31985 Pa. Find the height difference between the two columns.

[a] 0.3299 [b] 0.2399 [c] 0.4999 [d] 0.5399

7. Critical Temperature for water is [^{0} C]

[a] 347.14 [b] 357.14 [c] 367.14 [d] 374.14

8. A definite area (or) space where some thermodynamics process takes place is know as

[a] Thermodynamics system [b]] Thermodynamics sycle
[c] Thermodynamics process [d] Thermodynamics Law

9. Dryness fraction is the ratio of

[a] $\frac{M_f}{M_g + M_f}$ [b] $\frac{m_{fg}}{m_f + m_f}$ [c] $\frac{m_g}{m_g + m_f}$ [d] $\frac{V_f}{V_g + V_f}$

10. A vessel contains 3.0 kg of liquid water and vapour mixture in equilibrium at quality of 53 %. Find the mass of Liquid.

[a] 1.4 kg [b] 4.1 kg [c] 2.4 kg [d] 3.1 kg

**********a

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai
2nd Sem 11 Sec 2008-09

Subject: Thermodynamics
Course No: ES C 112

QUIZ III

DATE: / / 09
Duration: 15 Min **Max. Marks: 5**

Name of the student: ---------- **I.D.: ----------**

Qc	1	2	3	4	5	6	7	8	9	10
Ans										

[1] A 1200 kg car accelerates from zero to 100 km/h over a distance of 400 m. The road at the end of the 400 m is at 10 m higher elevation. What is the total increase in the car kinetic and potential energy?

[a] 116 kJ [b] 119 kJ [c] 120 kJ [d] 117 kJ

[2] During throttling process

[a] Internal energy does not change [b] Pressure does not change
[c]Entropy does not change [d]Enthalpy does not change

[3] A piston/cylinder contains 0.001 m^3 air at 300 K, 150 kPa. The air is now compressed in a process in which $P V^{1.25} = C$ to a final pressure of 600 kPa. Find the final air temperature.

[a] 393 K [b] 396 K [c] 397 K [d] 392 K

[4] Oxygen at 300 kPa, 100°C is in a piston/cylinder arrangement with a volume of 0.1 m^3. It is now compressed in a polytropic process with exponent, n = 1.2, to a final temperature of 200°C. Calculate the work done for the process.

[a] 40 kJ [b] 42 kJ [c] - 40 kJ [d] - 42 kJ

[5] A piston cylinder contains 0.1 kg air at 300 K and 100 kPa. The air is now slowly compressed in an isothermal (T = C) process to a final pressure of 250 kPa. Show find out the work in the process.

[a] 7.89 kJ [b] – 8.89 kJ [c] -7.89 kJ [d] 8.89 kJ

[6] A refrigerator operating on reversible cycle is pumping heat from – 5 ^{0} C space to the atmosphere at 40 ^{0} C. Find COP.

[a] 6.9 [b] 5.9 [c] 4.9 [d] 7.9

[7] A frictionless heat engine can be 100 % efficiency only if its exhaust temperature is

[a] - 100 ^{0} C [b] 0^0 K [c] 100 ^{0} C [d] Less than its input temperature

[8] $\int dQ / T = 0$ for _____ process

[a] Reversible [b] Irreversible [c] Isothermal process [d] Adiabatic process

[9] A hydraulic hoist raises a 1750 kg car 1.8 m in an auto repair shop. The hydraulic pump has a constant pressure of 800 kPa on its piston. How much volume should the pump displace to deliver that amount of work?

[a] 0.03 m^3 [b] 0.04 m^3 [c] 0.02 m^3 [d] 0.05 m^3

[10] A control volume refers to

[a] A fixed region in space [b] A specified mass
[c] A closed system [d] An isolated system

**********c

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai
I st yr 2nd Sem Sec -1I2008-09

Subject: aThermodynamics
Course No: ES C 112

QUIZ II

DATE: / / 08
Duration: 15 Min **Max. Marks: 5**

Name of the student: ---------- **I.D.: ----------**

Q	1	2	3	4	5	6	7	8	9	10
Ans										

1. First law thermodynamics can be written as

   [a] $E_1 - E_2 = {}_1W_2 - {}_1Q_2$ [b] $E_1 - E_2 = {}_2Q_1 - {}_2W_1$
   [c] $E_2 - E_1 = {}_1Q_2 - {}_1W_2$ [d] $E_2 - E_1 = {}_1Q_1 - {}_1W_1$

2. [10] A cylinder contains 0.45 m3 of a gas at 1 X 10^5 N/m^2. The gas is compressed to a volume of 0.13 m3, the final pressure being 5 X 10^5 N/m^2. Determine the value of index 'n' for the compression.

   [a] 1.2 [b] 1.4 [c] 1.5 [d] 1.6

3. In an I.C.Engine during compression stroke, the heat rejected to the cooling water is 50 kJ/kg and the work input is 100 kJ/kg. Find the I.E.

   [a] 50 kJ/kg [b] 54 kJ/kg [c] 52 kJ/kg [d] 49 kJ/kg

4. One kg of ideal gas is heated from 18 ^{0}C to 93 ^{0}C. Assume R = 264 J/kg k, Ratio of specific heats 1.18 for the gas. Find the value of specific heat at constant pressure (Cp).

   [a] 1.9 kJ/kg k [b] 1.5 kJ/kg k [c] 2.1 kJ/kg k [d] 1.7 kJ/kg k

5. Specific internal energy can be calculated by

   [a] $h_f + xh_{fg}$ [b] $u_{fg} + xu_f$ [c] $u_g + xu_{fg}$ [d] $u_f + xu_{fg}$

6. A 1-m^3 container is filled with 0.12 m^3 of granite with density of 2750 kg / m^3 and also filled with 0.15 m^3 of sand with density of 1500 kg / m^3. Find the overall specific volume.

[a] 1.8×10^{-3} kg / m^3 [b] 1.9×10^{-3} kg / m^3 [c] 1.7×10^{-3} kg / m^3
[d] 2.0×10^{-3} kg / m^3

7. A mercury (Hg) manometer is used to measure the pressure in a vessel. The mercury has density of 13590 kg / m^3 and gaguge pressure is 31985 Pa. Find the height difference between the two columns.

[a] 0.3299 [b] 0.2399 [c] 0.4999 [d] 0.5399

8. What is the volume of air having the mass of 280 kg, if the pressure is 100 kPa and the temperature is 298 K.

[a] 242 m^3 [b] 241 m^3 [c] 237 m^3 [d] 239 m^3

9. A vessel contains 3.0 kg of liquid water and vapour mixture in equilibrium at quality of 53 %. Find the mass of Liquid.

[a] 1.4 kg [b] 4.1 kg [c] 2.4 kg [d] 3.1 kg

10. In isothermal process

[a] Temperature increases gradually [b] Change in I.E. is zero
[c] Volume remains constant [d] Pressure remains constant

**********a

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai
2nd Sem Sec II- 2008-09

Subject: Thermodynamics
Course No: ES C 112

QUIZ I

DATE:25 / 02 / 09...
Duration: 15 Min **Max. Marks: 5**

Name of the student: ---------- I.D.: ----------

Q	1	2	3	4	5	6	7	8	9	10

1. One bar is equal to

[a] 1000 kPa [b] 100 MPa [c] 0.1 MPa [d] 10^7 Pa

2. A liquid of mass 18 kg is heated from 25 ^{0} C. to 85 ^{0} C. How much heat is required? Assume Cp for water is 4.2 kJ / kg.k.

[a] 4539 kW [b] 4533 kW [c] 4536 kW [d] 4530 kW

3. A mercury (Hg) manometer is used to measure the pressure in a vessel. The mercury has density of 13590 kg / m^3 and gauge pressure is 31985 Pa. Find the height difference between the two columns.

[a] 0.3299 [b] 0.2399 [c] 0.4999 [d] 0.5399

4. A vessel contains 3.0 kg of liquid water and vapour mixture in equilibrium at quality of 53 %. Find the mass of Liquid.

[a] 1.4 kg [b] 4.1 kg [c] 2.4 kg [d] 3.1 kg

5. A tube contains an oil of specific gravity 0.9 to a depth of 120 cm. Find the gauge pressure at this depth.

[a] 11594 N/ m^2 [b] 10594 N/ m^2 [c] 15094 N/ m^2
[d] 19544 N/ m^2

6. Work done by a substance in a reversible Non-flow manner in accordance with law $V = [700/P]\ m^3$. Evaluate the work done(or)by the substance as the pressure increases from 70 kPa to 700 kPa.

[a] - 1711 KJ [b] - 1611 KJ [c] - 1511 KJ [d] -1811 KJ

7. Critical Pressure for water is [Mpa]

[a] 23.09 [b] 21.09 [c] 24.09 [d] 22.09

8. Which of the following is an Extensive property of a Thermodynamic System?

[a] Pressure [b] Volume [c] Temperature [d] Density

9. When the gas is heated at constant pressure, the heat supplied

[a] Increase the I.E of the gas
[b] Increase the temperature of the gas
[c] Does some external work
[d] Both (b) and (c)

10. Internal Energy of a perfect gas depends on

[a] Temperature, Specific heat and pressure
[b] Temperature, Specific heat and Enthalpy
[c] Temperature, Specific heat and Entropy
[d] Temperature only