COVENANT UNIVERSITY

COLLEGE OF SCIENCE AND TECHNOLOGY

2011/2012 Omega Mid-Semester Test 2, May, 2012

Course Code: GEC 221 (Thermodynamics)

Duration: 20 mins

It is necessary to store 1 *lb mole* of methane at temperature of 122°F and a pressure of 600 *atm*.

Given *R* (universal gas law constant) = 0.7302 $\frac{ft^3\ atm}{lb\ mole\ °R}$ and

°*R* (degree Rankine) = °F + 460. Use this information for Question 1 & 2.

1. What is the volume of the vessel that must be provided (Use the Ideal Gas Law)? (3 marks)

2. What is the value of the volume in Q1 in S.I. unit? $(1m = 3.2808ft)$ (2 marks)

3. Which of these is not a form of stored energy in a system;
   (a) Latent (b) Work (c) Nuclear (d) Chemical

4. In the heat engine; (1 mark)
   (a) heat is converted to work (b) work is converted to heat (c) thermal efficiency = $\frac{Q_H}{W}$

5. ..... can be used to measure enthalpy. (1 mark)

6. The non-thermodynamic property W can be measured directly by ..... (1 mark)

7. In the series $PV = a(1 + B'P + C'p^2 + \cdots)$, the constants are functions of ..... (1 mark)

ANSWERS TO GEC 221 OMEGA MID-SEMESTER EXAMS 2011/12

1. Answer: $\mathbf{0.7083\ ft^3}$

   Given,

   $P = 600\ atm;\ T = 122°\text{F} = 122°\text{F} + 460 = 582°R;\quad n = 1\ lb\ mole$

   $R = 0.7302 \frac{ft^3 atm}{lb\ mole\ °R}$

   Ideal Gas Law,

   $PV = nRT$

   $\therefore V = \frac{nRT}{P} = \frac{1 \times 0.7302 \times 582}{600} = \mathbf{0.7083\ ft^3}$

2. Answer: $\mathbf{0.0201 m^3}$

   $1m = 3.2808\ ft$

   $1m \times 1m \times 1m = 3.2808\ ft \times 3.2808\ ft \times 3.2808\ ft$

   $1m^3 = 35.313 ft^3$

   $\therefore 0.7083\ ft^3 = \frac{0.7083}{35.313} = \mathbf{0.0201 m^3}$

3. Answer: **B**
4. Answer: **A**
5. ***Calorimeter***
6. ***Dynamometer***
7. ***Temperature and Chemical Species***

COVENANT UNIVERSITY

COLLEGE OF SCIENCE AND TECHNOLOGY

2011/2012 OMEGA SEMESTER EXAMINATION, JUNE, 2012

COURSE CODE: GEC 221 (Thermodynamics)

DURATION: 2 hours

INSTRUCTION: **Answer all questions**

1. Define an open system (1 mark)

2. The second law of thermodynamics could be written as (1 mark)

   (a) $dU = dQ - PdV$ (b) $dU = TdS - PdV$ (c) $dU = dQ - PdV$ (d) $dS = \frac{dQ}{T}$

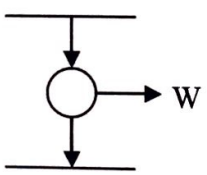
A garden hose attached with a nozzle is used to fill a 10,000 cm^3 bucket. The inner diameter of the hose is 0.02 m, and it reduces to 0.008 m at the nozzle exit. If it takes 40 seconds to fill the bucket with water, taking density of water to be 10^3 kg/m^3 determine the:

3. The volume flow rate through the hose (3 marks)
4. Mass flow rate through the hose (3 marks)
5. An isentropic process means

   (a) $dQ = 0$ and $dS = 0$ (b) $dH = 0$ and $dS = 0$ (c) $dQ = 0$ and $dH = 0$

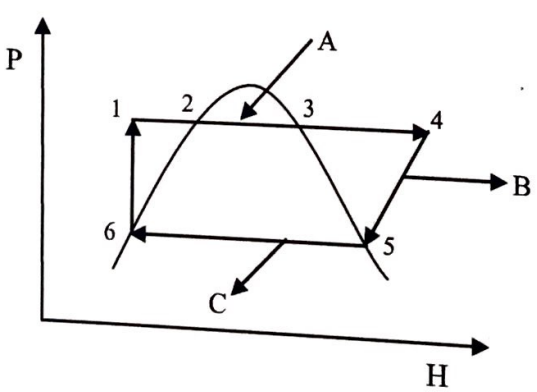
   (d) $\dot{P} = 0$ and $dQ = 0$
6. The principle of a Heat Engine Cycle can be represented as in Figure 1 below. Present the practical Heat Engine Cycle (as block diagram) with relevant labels. (6 marks)

Figure 1.



A Heat Engine using water as working fluid operates between boiler (BO) and condenser (CO) temperature of 230°C and 100°C, respectively. The Heat Engine Cycle represented on a Pressure versus Enthalpy diagram is shown in Figure 2. Use the Figure to answer 7 – 14 (11 marks).

Figure 2



7. A, B, and C represent ....., ..., ... respectively.

Given that lin 1 – 4 represents Isobaric, Isothermal evaporation

8. Line 4 – 5 represents .....
9. Line 5 – 6 represents .....
10. Line 6 – 1 represents .....
11. The fluid at Point 1 is .....
12. The fluid at Point 2 is .....
13. The fluid at Point 3 is .....
14. The fluid at Point 4 is .....

15. Using the steam tables, supply the values in Table 1 for the various numerical points in Figure 2. (7 marks)

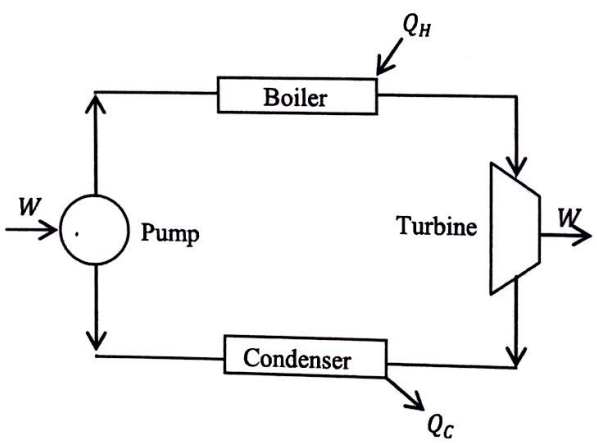
Table 1

	Temperature (K)	Pressure (bar)	Enthalpy, H (kJ/kg)	Entropy, S (kJ/kg.K)
1				
2				
3				
4				
5				
6				

16. Calculate Q_{BO} and Q_{CO} (6 points)
17. Calculate the Rankine thermal effeciency (3 marks)
18. Calculate the Carnot thermal efficiency (3 marks)
19. Calculate the effectiveness, ξ of the Heat Engine (2 marks)
20. Which of the following sets of variables contains only thermodynamic properties
    a) work, heat, heat capacity, specific heat b) temp, viscosity, kinematic viscosity, stress
    c) specific volume, specific heat, specific mass, temperature d) density, pressure, temperature, specific heat at constant volume
21. Intensive properties are those which are independent of
    a) mass b) type of process, mass and past history c) type of contour, mass and condition
    d) path, mass and temperature
22. A reversible system is
    a) necessarily cyclic b) goes through a series of equilibrium stages c) goes through a parallel of equilibrium stages d) is a rate process
23. For a given material the second viral coefficient B is a function of
    a) temperature only b) temperature and pressure c) temperature, pressure, gravity and velocity
    d) its properties only

ANSWERS TO GEC 221 OMEGA SEMESTER EXAM 2011/2012

1. An ***open system*** is a system that allows the exchange of both mass and energy across its boundaries.
2. $du = Tds - PdV$

   inner diameter of hose = $0.02\ m$
   inner diameter of nozzle = $0.008m$
   time taken to fill bucket, $t = 40\ s$
   volume of bucket, $V = 10{,}000\ cm^3$
   $10{,}000\ cm^3 = \left(\frac{10{,}000}{1{,}000.000}\right) m^3$
   $= 0.01m^3$
   C, density of water = $10^3 kg/m^3$
3. Volumetric flow rate = $\frac{\text{Volume}}{\text{Time}} = \frac{0.01}{40} = 2.5 \times 10^{-4}\ m^3/s$
4. Mass flow rate = Volumetric flow rate × destiny
   $= 2.5 \times 10^{-4} \times 10^3 kg/m^3$
   $= 0.25\ kg/s$
5. (A)
6. 

7. Q_H W and Q_C
8. Isentropic process
9. Isobaric process
10. Isenthalpic process
11. Sub cooled liquids
12. Saturated liquids
13. Saturated vapour
14. Super heated vapour

COVENANT UNIVERSITY
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TITLE OF EXAMINATION: B.Eng EXAMINATION
COLLEGE: ENGINEERING
COURSE CODE: GEC 221
COURSE TITLE: ENGINEERING THERMODYNAMICS
INSTRUCTIONS: Answer ALL questions

SESSION: 2015/2016
CREDIT UNITS: 2 UNITS

ASSESSMENT TEST

PART A – (15 MARKS)

(1) Thermodynamics was obtained from two greek words namely
..... and ..... (2 marks)

(2) ..... is a part of thermodynamics deals with thermal equilibrium and provides a means of measuring temperature (1 mark)

(3) When is a system in thermal equilibrium?
.....
..... (2 marks)

(4) The path followed by a system in reading a given final state of equilibrium state is called
..... (1 mark)

(5) Volume and energy are examples of ..... properties (2 marks)

(6) As microscopic approach is to Statistical Thermodynamics, macroscopic is to
..... (1 mark)

(7) Properties that are independent of the mass of a system are
..... (1 mark)

(8) Adiabatic process is a process in which .....
..... (1 mark)

(9) Under what conditions is a system considered a closed system?
.....
..... (1 mark)

(10) Given that 1 ib_r = 4.4482 N and 1m = 39.37 in convert, 700 ib_f/in^2 to N/m^2

.....

.....

.....

PART B (15 MARKS)

(11) The two forms of transient energy are ..... and ..... (2 Marks)

(12) Define the following terms (i) Isobaric (ii) Isochoric (iii) Boundary (3 marks)

.....

.....

.....

.....

(13) First Law of Thermodynamics is also referred to as .....

..... (1 mark)

(14) The mathematical expression for a closed system ..... (1 mark)

(15) In an isolated system Q and W are ..... (1 mark)

(16) Mechanical equilibrium occurs when there is no change in .....

at any point of the system with time (1 Mark)

(17) A process during which there is no hear transfer is called ..... (1 Mark)

The mass of an unknown gas mixture in a room that is 4m x 3m x 5m in is known to be 600kg.

Use this information to answer Questions (18-19)

(18) What is the density of the gas?

.....

.....

..... (2 marks)

(19) What is the specific volume of the gas?

.....

.....

..... (2 marks)

(20) Which of the following expressions can be converted to the unit of a Joule (J)?

(a) Pa x m^2 (b) Pa x m^3 (c) Pa/m^2 (d) N/Kg (e) None of the above.

(1 mark)

ANSWERS TO GEC 221 OMEGA MID-SEMSTER EXAM 2015/2016

1. Therme and Dynamics.
2. First law of thermodynamics.
3. A system is in thermal equilibrium when there is no change in heat with time i.e. $dq = 0$.
4. A cycle (process).
5. Extensive.
6. Classical Thermodynamics.
7. Intensive properties.
8. $\Delta q = 0$; a process in which there is no heat change.
9. A system is considered closed if energy can move out/ interact with the surrounding while mass cannot.
10. Given that 39.37inch = 1m, 1 inch = 0.0250m
    Converting 700lb/in^2 to N/m^2
    We have
    $$\frac{700 \times 4.4482}{(0.0254)^2} = \frac{700\times 4.4482}{6.4516 \times 10^{-4}} = 4826287.3\frac{N^2}{m}$$
    $= 4.82 \times 10^{-6} N/m^2$.
11. Heat and work.
12. ***Isobaric:*** this means that pressure is constant i.e. no change in pressure.
    Isochoric: an isochoric system is a system with constant volume i.e. no change in volume.
    Boundary: a boundary is the interface between a system and its surroundings.
13. Law of energy conversion or law of conservation of energy.
14. $Q - M = E$.
15. Q and W are equal to 0.
16. Force.
17. Adiabatic process.
18. Volume = 4m × 3m × 5m = $60m^3$, mass was given to be 600kg;
    Density = $\frac{mass}{volume} = \frac{600}{60}$
    =10kg/m^3.
19. Specific volume, v = $\frac{volume}{mass} = \frac{1}{density} = \frac{1}{10}$
    $= 0.1\ m^3/kg$.
20. Pa × m^3.