TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS I
BACHELOR OF TECHNOLOGY IN RENEWABLE ENERGY
(BTAP/BTRE)

APS 4204: THERMAL PHYSICS I

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FOUR** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Explain THREE means of heat transfer and give application of each **(6 marks)**

b) State Stefan's Law **(2 marks)**

c) Determine the change in entropy of 3kg of water at 100^{o}C (Specific latent heat of vaporization of water = 2.26 x 106Jkg^{-1} at 100^{o}C) **(5 marks)**

d) State and explain the principle of increase of entropy **(4 marks)**

e) Define the following terms:
- **(i)** Endothermic
- **(ii)** Adiabatic

(iii) Exothermic

f) Explain the heat engine cycle of operation **(4 marks)**

Question Two

a) State the second law of thermodynamics **(2 marks)**

b) 5kg of water are heated from 0°C to 100°C by being placed in contact with a body which has a large heat capacity and which is itself at 100°C. Determine changes in entropy of:
   (i) Water
   (ii) Universe

   (Specific heat capacity of water in the range 0°C to 100°C = 4.2×10^3 $Jkg^{-1}k^{-1}$ **(10 marks)**

c) Explain conduction mechanism in:
   (i) Gases
   (ii) Non-metallic solids and liquids
   (iii) Metals **(8 marks)**

Question Three

a) Explain what is meant by black body and black body radiation **(4 marks)**

b) A 100w electric light bulb has a filament which is 0.6m long and has a diameter of 8.0×10^{-5}m. Estimate the working temperature of the filament if its total emissivity is 0.7 (Stefan's constant = 5.7 x $108Nm^{-2}k^{-4}$) **(6 marks)**

c) Determine
   (i) Increase in enthalpy and:
   (ii) Increase in internal energy when 4kg of water at 100°C and pressure of 1.013×10^5Pa is turned into steam at the same temperatures and pressure (Specific enthalpy change for the conversion of water to steam at 100°C = $2.261 \times 10^6 Jkg^{-1}$, specific volume of water at 100°C = 1.637 m^3 kg^{-1})
   (10 marks)

Question Four

a) Determine the volume of 1 mole of gas at STP (R = 8.31 $Jkg^{-1}mol^{-1}$) **(3 marks)**

b) Sketch a PV diagram of idealized diesel and explain the cycle and operations.

c) (i) Explain FOUR disadvantages, of liquid-in-glass thermometers. **(4 marks)**
   (ii) Discuss THREE advantages of mercury as a thermometric liquid **(3 marks)**

Question Five

a) State Avogadro's Law **(2 marks)**

b) A quantity of low-density gas in a rigid container is initially at room temperature (20°C) and a particular pressure (P). If the gas is heated to a temperature of 60°C by what factor does the pressure change? **(5 marks)**

c) A particular resistance thermometer has a resistance of 30Ω at the ice point 41.58Ω at the steam point and 34.5 Ω when immersed in a boiling liquid. A constant volume gas thermometer gives readings of 1.333×10^5Pa, 1.821×10^5 Pa and 1.528×10^5Pa, at the same three temperatures. Determine the temperature at which the liquid is boiling:

(i) On the scale of gas thermometer

(ii) On the scale of resistance thermometer **(10 marks)**

d) Explain Newton's Law of Cooling **(3 marks)**