THE OPEN UNIVERSITY OF SRI LANKA

BACHELOR OF INDUSTRIAL STUDIES/ BACHELOR OF TECHNOLOGY

FINAL EXAMINATION – 2012/2013

TTX5234 – PLANT UTILITIES

DURATION – THREE HOURS

DATE: 12th August 2013   TIME: 1330 – 1630 hours

Total Number of Questions = 09   **Number of Questions to be answered = 06**

Answer the question 1, <u>which is compulsory,</u> and five (05) additional questions.
Question 1 carries twenty five (25) marks and questions 02 to 08 carry fifteen (15) marks each.

01.a) Giving examples, explain the terms "Ultimate Sources of Energy", "Primary Sources of Energy" and "Secondary Sources of Energy".   **(6 marks)**

   b) When a fluid moves, energy can change forms, but its total energy remains constant.

       Express the above idea with an equation, by identifying the different forms of energy in a moving fluid.   **(3 marks)**

   c) Give two examples, for producing electricity by harnessing energy from water and air.

                                                                                    (2 marks)

   d) Explain the generation of electric voltage, through Faraday's Law of Induction.   **(2 marks)**

   e) Explain why and how transformers are used, when transmitting electricity.   **(3 marks)**

   f) What do you understand by "Fractional Distillation", "Cracking" and "Unification" of crude oil refining process?   **(3 marks)**

   g) Explain the spontaneous radioactive decay by "Alpha Emission" "Beta Decay" and "Gamna Emission ", giving the changes that occur in the nucleus of the atom, if any.   **(6 marks)**

02.   In case of boiler feed water, for steam generation, what are the important properties that we need to consider? How can each of these properties, affect the boiler? Through which processes are they eliminated or reduced?   **(15 marks)**

03. a) Explain the terms;

    i) Wet steam   ii) Dry steam   iii) Super heated steam

    iv)Liquid Enthalpy   v)Enthalpy of Evaporation   vi) Super heated vapour enthalpy

    vii) Saturation temperature   **(7 marks)**

    b) Sketch "Temperature – Enthalpy" curves of steam at three different, constant pressures $P_1 < P_2 < P_3$. Indicate 'specific liquid enthalpy (h_f) , "specific enthalpy of evaporation (h_{fg})" of the curve, relevant to constant pressure P_1.   **(8 marks)**

04. Following readings at 9 bar are taken from a steam table.

P in bars	T_s in °C	V_g in m³ / kg	U_f in kJ / kg	U_g in kJ / kg	h_f in kJ / kg	h_{fg} in kJ / kg	h_g in kJ / kg
9	175.4	0.2149	742	2581	743	2031	2774

What are the specific internal energy and specific enthalpy values at 90% dry steam at 9 bar?

                                                           (15 marks)

05. a) What are the advantages of a well designed lighting system in a factory?   **(5 marks)**

    b) Define the terms, "Luminous flux", "Luminous intensity" and "Illumination".

                                                            (3 marks)

    c) Express the three laws of Illumination.   **(3 marks)**

    d) A lamp has a luminous intensity of 200 candle power in all directions. It is placed at a height of 2m over a working plane of 4mx3m. Find the illumination;

        i) At a point on the ground directly under the amp

        ii) At a corner of the working plane.   **(4 marks)**

06. a) Define the terms; "Dry Bulb Temperature", "Wet Bulb Temperature", "Dew Point Temperature", and "Relative Humidity".   (4 marks)

   b) Calculate the enthalpy of 1 kg of dry air of the temperature 25°C having a humidity ratio of 0.025kg of moisture in one kg of dry air,

$$C_{p,air} = 1.04 \frac{kJ}{kg°C} \quad , C_{p,vapour} = 2.093 \frac{kJ}{kg°C} \quad , r_0 = 2258 \frac{kJ}{kg}$$

   (You need not, simplify the answer !!)

   c) Locate and number the following conditions on the psychometric chart.

   i)   Condition of 35°C dry bulb temperature and 0.008kg moisture in 1kg of dry air.

   ii) Condition of 30°C dry bulb and 18.5 °C Wet bulb temperature.

   iii) Condition of 60% relative humidity and 0.012 kg moisture in 1kg dry air.

   iv) Condition of 0.95 m³/kg of specific volume and 40% relative humidity.   **(4 marks)**

07. Explain the following processes involved with air conditioning, indicating outcome of each process as it would appear on a psychometric chart.

   i)   Sensible heating

   ii) Sensible cooling

   iii) Evaporative cooling or Adiabatic Saturation

   iv) Spraying hot or cold water   **(15 marks)**

)08

08. a) What do you understand by the following abbreviations?
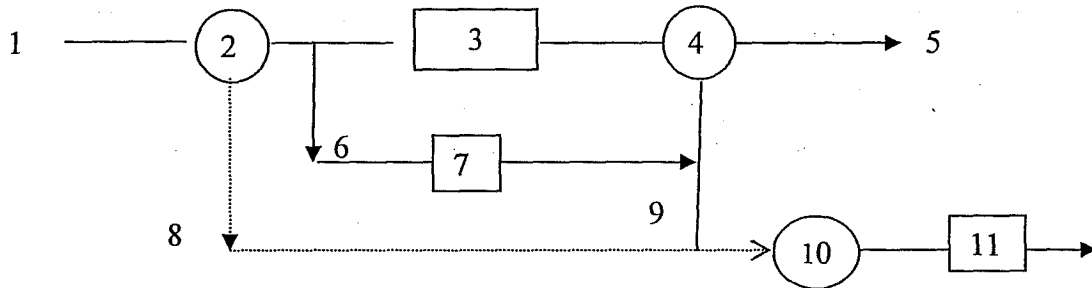
TDS, DO, BOD, COD, SS   (5 marks)

b) What is the electrical property used to find the quantity of dissolved salts in water?

(1 mark)

c) Given below is an outline of a typical Activated Sludge Process for treatment of waste water. Name the numbered elements of the process.   (9 marks)

09. a) How do you distinguish between "Safety Engineering" and "Safety Management"?

(2 marks)

b) In safety engineering the first step is identifying hazards. State at least eight accident causing energy hazards.   (7 marks)

c) In order to know the danger related to a particular hazard, we have to examine the risk factors. Risk can be measured as the product of three components. What are these components?   (3 marks)

d) There are three methods to control hazards. Explain those three methods.   (3 marks)
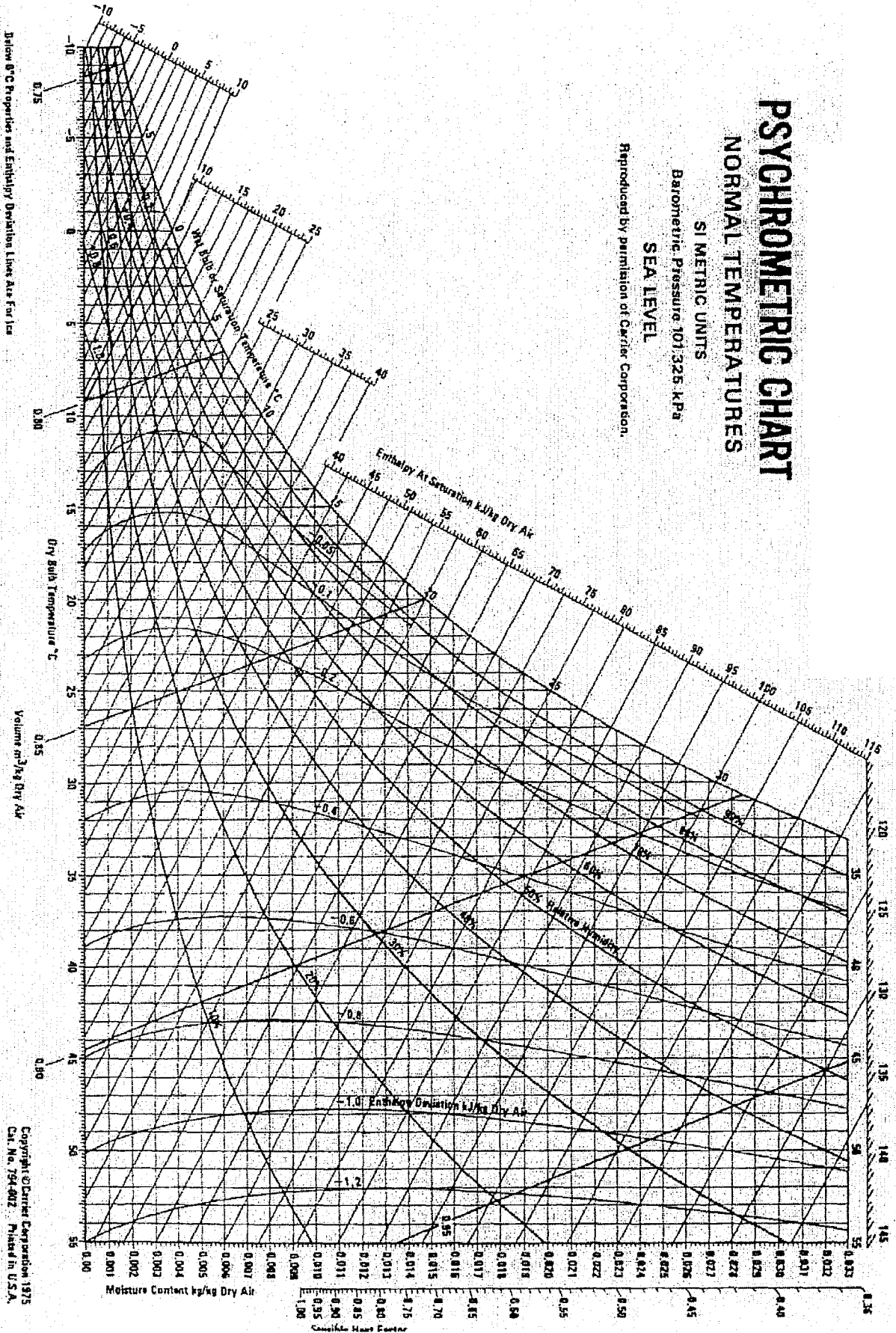
RJ/2013

PSYCHROMETRIC CHART
NORMAL TEMPERATURES

SI METRIC UNITS

Barometric Pressure 101.325 kPa

SEA LEVEL

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Wet Bulb or Saturation Temperature °C

Enthalpy At Saturation kJ/kg Dry Air

Dry Bulb Temperature °C

Volume m³/kg Dry Air

Relative Humidity

Enthalpy Deviation kJ/kg Dry Air

Below 0°C Properties and Enthalpy Deviation Lines Are For Ice

Moisture Content kg/kg Dry Air

Sensible Heat Factor