THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF INDUSTRIAL STUDIES/ BACHELOR OF TECHNOLOGY

066

FINAL EXAMINATION – 2008/2009

TTX5234 PLANT UTILITIES

DURATION THREE (3) HOURS

Date: 28TH March 2009 **Time: 0930 -1230 hours**

Answer six (6) questions including Question Number one (1) which is compulsory. Question number 1 carries 25 marks, and all the other questions carry 15 marks each. Psychrometric chart is also provided.

1. a. Why is the "internal combustion engine", is referred to by that name? **(1 mark)**

b. State three advantages of the "diesel cycle" over the "otto cycle". **(3 marks)**

c. When you consider the behaviour of fluids in motion, how would you differentiate, "steady flow" and "turbulent flow"? **(2 marks)**

d. Identify the most suitable words to be substituted for blanks numbered I, 2, 3 and 4.

A turbine is a device, which converts .....(1) and .....(2) of a moving fluid into some form of mechanical work.
When the rotor is moved by a direct push from the fluid, impinging upon the blades, the turbine is called a .....(3), and when the rotor is turned by force of reaction, it is called .....(4) turbine. **(2 marks)**

e. What is the purpose of adding softner to boiler-makeup water? **(1 mark)**

f. What is the importance of "de-aeration" of boiler feed water? How is it done? **(3 marks)**

g. What are the purposes of air conditioning in an industrial environment? **(2 marks)**

h. What do you understand by the following abbreviations? **(5 marks)**

TDS DO BOD COD SS

i. Draw a schematic diagram of transmission of power from the stage of generation to final consumer and explain how the electric losses are reduced by operating transmission lines at high voltage? **(4 marks)**

j. According to Faraday's Law what are the two factors that contribute to the strength of the induced voltage? **(2 marks)**

2. Draw the Pressure- Volume (P-V) diagram and Absolute Temperature - Entropy (T-S) diagram of the Carnot Cycle and explain what happens during the each process. **(15 marks)**

3. State and explain the Burnoulli's Equation, with the help of a schematic diagram. What are the assumptions made, and the basis of derivation of the equation? **(15 marks)**

4. a) Explain the following processes connected with crude oil refining process. **(12 marks)**

   i. Fractional Distillation
   ii. Cracking
   iii. Unification
   iv. Alteration

   b) With the aid of a schematic diagram, explain the hydropower generating principle. **(3 marks)**

5. a) What do you understand by "Liquid Enthalpy", "Enthalpy of Evaporation", and "Superheated Vapour Enthalpy"? **(3 marks)**

   b) Draw the Temperature – Enthalpy graph for the process of conversion of water at room temperature to super heated steam at a constant pressure p_1. Indicate the Liquid Enthalpy (h_f), Enthalpy of Evaporation (h_{fg}), and Enthalpy of dry saturated Vapour (h_g) along the enthalpy axis of the graph. **(8 marks)**

   c) On the same diagram, draw the Temperature-Enthalpy graph of the same process, at a constant pressure p_2, where $p_2 > p_1$. **(2 marks)**

   d) Express the total Enthalpy (h) of wet vapour of Dryness Fraction "X", in terms of Liquid Enthalpy (h_f) and Enthalpy of Evaporation (h_{fg}). **(2 marks)**

6. a) State the three Laws of Illumination. **(6 marks)**

   b) A lamp has a luminous intensity of 90 candle power in all directions. It is placed at a height of 3m above the middle point of a working plane of 4m x 3m. Find the illumination,
   i. At a point on the working plane, directly under the lamp.
   ii. At one corner of the working plane. **(9 marks)**

7. a) Calculate the enthalpy of 1 kg of humid air, having a humidity of 0.015 kg of moisture, at a temperature of 60^0C. ***(Not necessary to simplify the answer)*** **(3 marks)**

   C_{pair} = 1.04 kJ/kg ^{0}C; $C_{p\ vapour}$ = 2.093 kJ/kg^{0}C r_0 = 2258 kJ/kg

b) Locate the following conditions on the psychrometric chart. **(3 marks)**

i. Condition of 40^0C dry bulb temperature and 0.010 kg moisture in 1 kg of air.
ii. Condition of 28^0C dry bulb temperature and 23^0C wet bulb temperature
iii. Condition of 30% Relative Humidity and 0.014 kg moisture in 1kg of air.

c) During air conditioning, we have to change the condition of air from one state to another, by different processes.

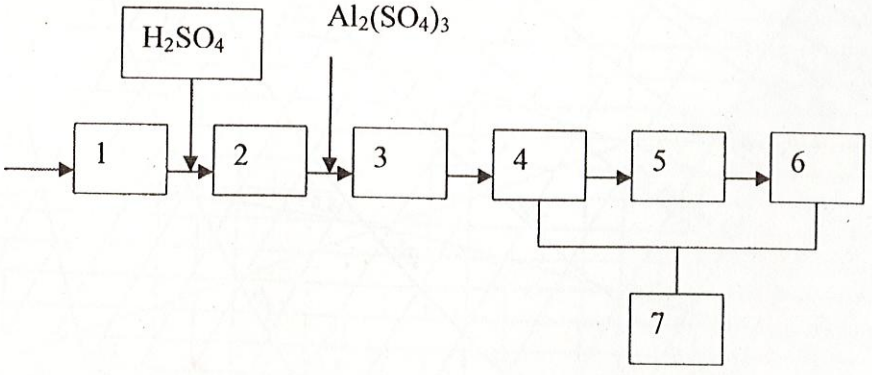
i. What happens to Temperature and Enthalpy of air, during sensible heating? **(2 marks)**
ii. What happens to temperature, enthalpy and water content of the air during sensible cooling? **(3 marks)**
iii. What happens to the temperature, relative humidity, enthalpy, absolute humidity, during adiabatic saturation or evaporative cooling of air? **(4 marks)**

8. State the physical and chemical characteristics of water and briefly explain the importance of each characteristic. **(15 marks)**

9. a) If you are to design an industrial effluent treatment plant, what are the parameters or information that you would have to establish, to characterize the effluent? **(9 marks)**

b) Explain the purposes of physical, chemical and biological processes of effluent treatment and state at least two different individual processes that can be categorized under each process. (e.g. "Screening" is one process that can be categorized under physical processes). **(3 marks)**

10. Given below, is a waste water treatment system applicable to chemical industry. What do the numbers (1) to (7) indicate? Explain the process briefly. **(15 marks)**



11.a) What do you understand by "Safety Engineering" and "Safety management"? **(6 marks)**
b) Identify all the forms of accident causing energies, and briefly explain three forms of energy hazards. **(9 marks)**

PSYCHROMETRIC CHART

NORMAL TEMPERATURES

SI METRIC UNITS

Barometric Pressure 101.325 kPa

SEA LEVEL