NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
Part Five Supplementary Examination 2014

TCE 5217 Industrial Energy Management

Duration of Examination 3 Hours

Instructions to Candidates

1. Answer **Question One** and any other **Three** questions.
2. Show all your steps clearly in your calculation.
3. Start the answers for each question on a new page.

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1. a) Energy Management is not an event but a process that involves energy auditing as well as a number of other key elements. State and explain these key elements. [5]

   b) What do you understand by the following words?
   - i) hertz [1]
   - ii) duty [1]
   - iii) RPM [1]
   - iv) HP [1]
   - v) energy plant survey [1]

   c) As an engineer, one is required to make investment decisions. Which investment tool would you use to aid your decision between return on investment (ROI) and simple payback period (SPB). [6]

   d) Explain why life cycle costing is the preferred method for analyzing incremental cashflows. [3]

   e) Briefly describe how motor losses can be reduced. [6]

2. a) Define service factor and explain what a service factor of 1 implies. [5]

   b) With the aid of a diagram, explain how fluorescent lamps work? [5]

   c) What is the practical significance of cost intensity and energy intensity? [6]

d) What is Life cycle costing analysis? [3]

e) Using relevant examples from the study of pumps, explain the maintenance opportunities that exist. [6]

3. a) Compare and contrast induction motors and standard motors. [4]

b) State the equations for reflectance factor and transmittance factor. Explain how the knowledge of each factor aids energy management. [6]

c) A tank 2m long x 1m wide x 1m deep, is not insulated, even though the tank was maintained at 175°C for 8760 hours per year. (Assume 25°C ambient temperature.) Estimate the potential energy and cost savings if the vessel was insulated with a 100 mm thickness of mineral fibre insulation. [4]
Data : heat loss = 65W/m^2 bare flat surface heat loss = 2,650 W/m^2
cost for electricity = $ 0.05 /kWh

d) All buildings, plants or institutions are composed of three basic systems. Explain in detail the practical significance of this statement. [6]

e) Electricity tariffs in Zimbabwe are currently grouped into three classes. With the aid of a table illustrate these three classes and explain the objective of having them. [5]

4. a) In a room 4m x 8m, the total light incident on the horizontal workplane is 10 000 lm. A sheet of paper on the workplane has a reflectance factor of 70%. Calculate the illuminance on the workplane and the luminous exitance of the paper? [4]

b) Power utility companies have been encouraging their clients to replace incandescent light bulbs with "energy saver" light bulbs. Justify their campaign. [6]

c) State and explain the three key energy management opportunity classes for fans. Give two examples under each class. [8]

d) A bare 10 m^2 flat surface has a temperature of 145°C with ambient air at 20°C. Calculate the reduction in heat flow if this surface is insulated with 50 mm thick insulating material (t) having thermal conductivity (k) of 0.045 W/m°C? [7]
Assume surface resistance = 0.1 for first trial. Use data from figures at the end of the question paper.

5. a) Manufacturers of lighting equipment strive to increase lamp efficacy. What is lamp efficacy and why does it need to be increased? [4]

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b) State and explain five HVAC systems that can operate in a plant. [5]

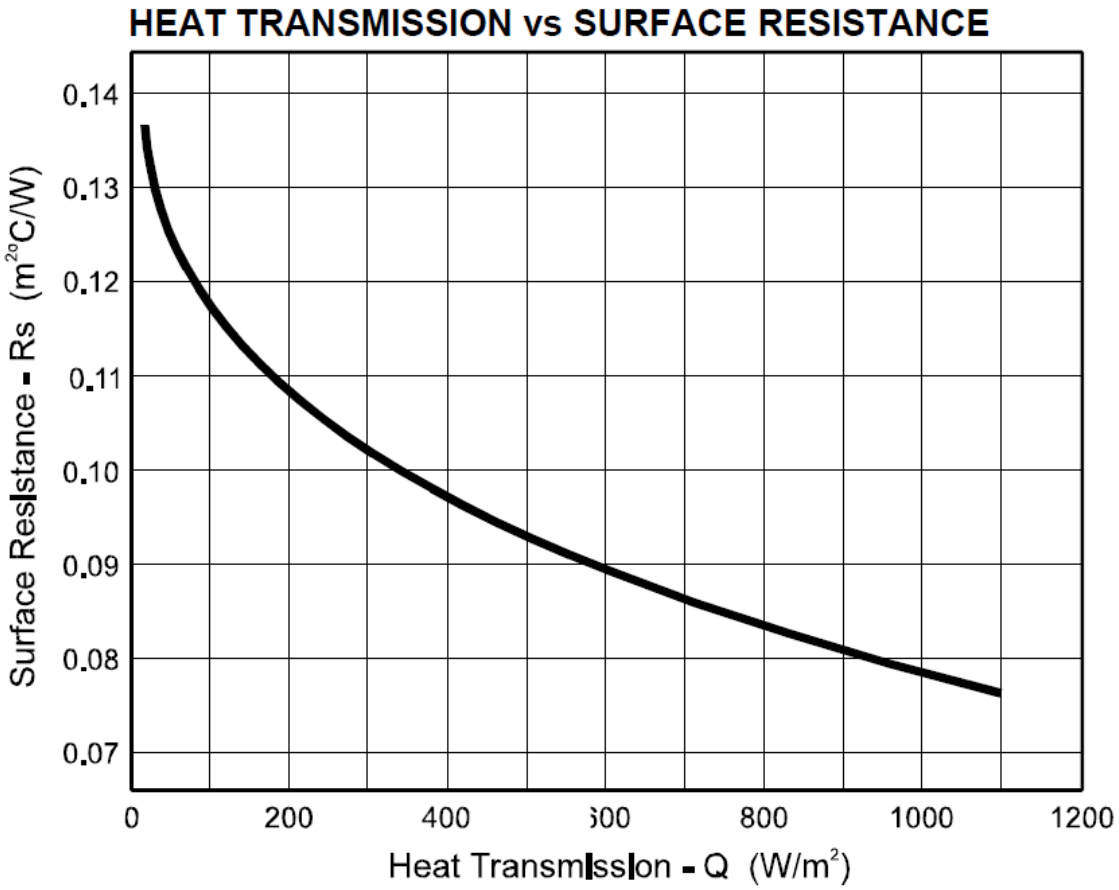
c) The supply utility provides a plant with 3-phase, 600 volt power. The actual phase to phase voltages (line voltages) were measured at 598V, 599V and 600V respectively. The measured three phase voltages, currents, and power factor levels were:

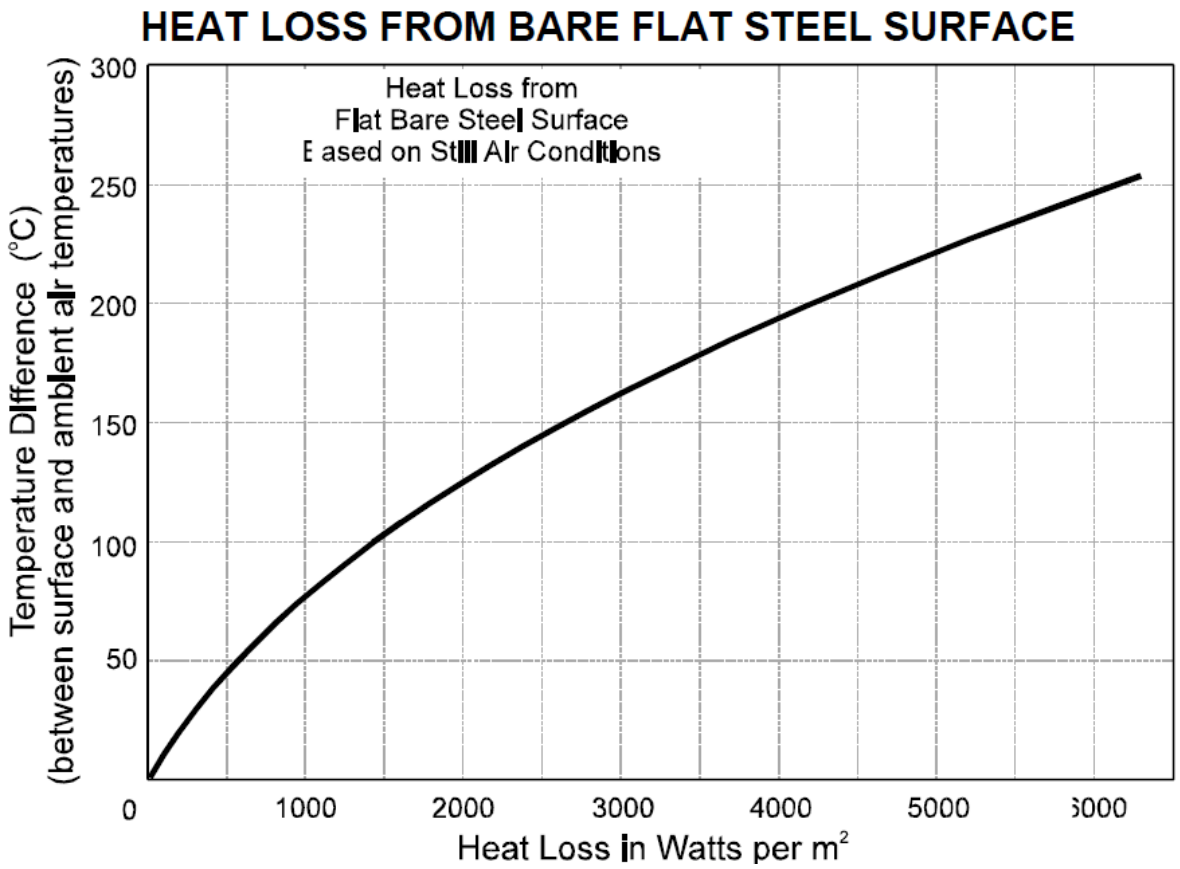
	A Phase	**B Phase**	**C Phase**
Voltage	345V	346V	346V
Current	220A	218A	215A
Power Factor	0.85	0.84	0.85

Calculate the total power, reactive power, active power and active energy? [5]

d) The economic recovery of waste heat depends on four main factors. State and explain these four main factors in detail highlighting their practical significance. [8]

e) Compare and contrast a fan from a blower. [3]




HEAT LOSS FROM BARE FLAT STEEL SURFACE
Heat Loss from
Flat Bare Steel Surface
Based on Still Air Conditions
Temperature Difference (°C)
(between surface and ambient air temperatures)
300
250
200
150
100
50
0
1000
2000
3000
4000
5000
6000
Heat Loss in Watts per m²

END OF EXAM