NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
Part Five Examination May 2011

TCE 5017 Industrial Energy Management

Duration of Examination 3Hours

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 terms? [5]
      i) process approach
      ii) energy data analysis
      iii) historical audit
      iv) energy cost ratios
      v) energy plant survey

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

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

   e) What is the practical significance of understanding the concepts of return on investment and simple payback period? Justify your answer with an energy management example. [6]

2. a) Outline the process of carrying out a life cycle cost analysis? [8]

   b) State the uses of the following instruments.

      i) portable digital thermometer
      ii) light meter
      iii) tachometer
      iv) psychrometer [4]

c) State and explain five HVAC systems that can operate in a plant? [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]

3. a) A large textile company identifies an opportunity to save money by recovering heat from hot waste water. A major source of hot water discharge in the textile industry is the griege preparation ranges which perform a continuous fabric washing operation. The discharge of the waste water from the griege preparation ranges is 1368 L/min at 71°C. Rather than discharging this water to drain, it was decided to preheat the 1368 L/min of cold inlet water having a yearly average temperature of 17.4°C, by passing it through a counterflow heat exchanger with automatic back flushing to reduce fouling, which is characteristic of textile processes. Based on a heat recovery factor of 58% and an operation of 4,440 hours per year, calculate
   i) the annual heat saving
   ii) annual saving
   iii) net annual saving

   [8]

   b) Define a boiler and describe any three types of boilers? [5]

   c) Describe in detail the process of feedwater treatment showing clearly the significance of this process in energy management? [8]

   d) Calculate plant demand from Speed of kWh Meter and from Plant Supplies given the following data:

   Plant Current (panel meter) = 265 Amps Plant Voltage (pane meter) = 380V

   Power Factor (panel meter) = 0.9

   kWh Meter Constant (from name plate) = 4.5 Rev/kWh

   The meter calibration includes current ct's

   Time for ten (10) revolutions of the meter disk = 49.5 seconds [4]

4. a) Using a schematic representation, explain in detail the concept of load shifting highlighting the role it plays in energy management? [6]

   b) Motor losses fall into four main categories. State and explain the four categories, include in your explanation the percentage losses of each category? [8]

   c) Define pour point and explain how the knowledge of pour point assists in industrial energy management? [5]

d) Explain what retrofit opportunities are using relevant examples from the study of refrigeration? [6]

5. a) 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? [7]

b) List the three types of the axial fans and state their uses? [6]

c) Complete the table below? [12]

Quality	**Measure of**	**Symbol**	**Unit**	**Definition**
Luminous Intensity		I		
	Total amount of light		Lumen (lm)	
Illuminance (illumination)		E		
	Density of light reflected or transmitted from a surface			A surface reflecting or emitting 1lumen per unit of area
Luminance (brightness)			cd/m^2	

END OF EXAM