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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	PLANT ENERGY EFFICIENCY
COURSE CODE	:	BNL 40303
PROGRAMME	:	BNL
EXAMINATION DATE	:	DECEMBER 2016 / JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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Q1 (a) The advancement of science and technology has brought about a large number of important changes towards conservation of energy. Answer the following question:

i. Energy management is the process of monitoring, controlling, and conserving energy in a building or an organization. Express the important roles of Plant Engineer in Energy Management.

(5 marks)

ii. The energy management is the application of efficient and effective ways in using of energy in order to maximize the profits and enhance for competitive positions. In your own words, describe the use of energy efficiency towards system efficiency, travel efficiency and vehicle efficiency.

(8 marks)

(b) Heated water from the boilers will flows through a network of pipes in a home. As the water flows, it dissipates heat throughout the home. Describe the concept and application of the of the pulverized fuel boiler and stoke fire boiler.

(7 marks)

(c) In Parit Raja, since the climate is milder, assume that TH is 70 °F and that TL is 40 °F. In Kemaman, assume that TH is the same, but that TL (the outside temperature) is much lower, say (on average), 15 °F. Compare the heating efficiencies (maximum COP) of the same heat pump installed in Parit Raja, Johor and in Kemanan, Terengganu.

(5 marks)

Q2 (a) Life cycle costing is an analysis of the total cost of the system, device, building. It has brought about a new emphasis on the comprehensive identification of all costs associated with a system. The most commonly included costs are initials in place cost, operating costs, operating costs, maintenance costs and interest on the investment. In your own words, Explain the factors below:

(i) Single Payment Compound Amount- F/P; and
(ii) Single Payment Presents Worth- P/F.

(5 marks)

(b) Lighting is a visible and very significant energy use in nonresidential buildings. The electrical lightning for buildings shows that the vast majority of the building's overhead lightning is provided by a repeating pattern of 2 x 2 foot square fluorescent fixtures, each with two 34-watt lamps. There are approximately 150 fixtures on each of the 4 floors, for a total of 599 fixtures. Calculate the annual overhead lightning electrical usage for the buildings includes with 10% for ballast. Refer **Table Q2 (b)** below for overhead lighting electrical usage.

Table Q2 (b): Overhead lighting electrical

Item	Mon-Fri		Saturday		Sunday		Hours Per Week	Weeks Per Year
Office overhead Lighting	On	Off	On	Off	On	Off		
10% on 90% on 30% on	Cont. 7:00a.m	10.00p.m	Cont. 8:00 a.m	2.30 p.m	Cont.		168 75 6.5	52 50 50

(10 marks)

(c) A typical office building is occupied by 450 workers and it is estimated that each person uses 1 gallon of lavatory hot water each day. The electrical usage for 1 gallon is 0.170 kWh/gal. Calculate the annual electrical use for water heating.

(5 marks)

(d) In buildings, where entire electrical panels are dedicated to lightning, it is possible to measure the amperage of the lightning use in order to make an estimate of annual consumption. The three wires are divided into a 277/480 – volt three phase lightning panel which measure 12.2 amps, 18.6 amps and 15.3 amps, respectively. Estimate the average of the panels using three phase method by referring **Table Q2 (c)**.

Table Q2 (c): Operating schedule for energy-consuming equipment.

Item	Mon-Fri		Saturday		Sunday		Hours Per Week	Weeks Per Year
Office equipment	*On*	*Off*	*On*	*Off*	*On*	*Off*		
75% on *25% on*	8.00 a.m	5.00 p.m	Cont		Cont		*148* *168*	*50* *52*

(5 marks)

Q3 The compressed air system supplied with screw compressor driven by a 160 kW electric motor. The maximum Rated Free Air Delivery is 350 l/s. The compressor is run for 6,000 hours/year. Calculate the annual cost of air leaks. The following measurements have been collected for a typical load cycle of the compressor:

The current for the 3 phase's measurement:

	Loaded	**Unloaded**
Phase 1	243	178
Phase 2	245	176
Phase 3	247	178
Average	**245**	**177.4**

The times for load-unload cycle during production are:

Loaded (sec)	**Unloaded (sec)**	**Total Cycle (sec)**
50	10	60
51	8	59
51	9	60
50	11	61

The times for load-unload cycles outside production hours are:

Loaded (sec)	**Unloaded (sec)**	**Total Cycle (sec)**
25	20	45
26	22	48
25	21	46
27	20	47

(i) Estimate compressor load (kW).
(ii) Calculate compressor average load (kW) during production period.
(iii) Estimate the compressor power during the leak test.
(iv) Estimate energy and cost due to leaks.
(v) Estimate cost saving from leak reduction program.

(25 marks)

Q4 (a) Cooling tower is a special recycling device which applies the heat rejection process. **Figure Q4 (a)** shows the cooling tower system that extracts waste heat to the atmosphere through the cooling of a water stream to a lower temperature. Sketch the *water recycle* in the cooling tower.

(5 marks)

(b) High leaving water temperature will cause a drop in process cooling efficiency, increasing system power consumption, creating physical discomfort to people within an air-conditioned area, and have a detrimental effect on other system components. In order to achieve optimum efficiency for operation and maintenance, discuss the *major factors* that affect the *cooling tower performance* in the leaving water temperature.

(8 marks)

(c) Cooling towers are special direct-contact heat exchangers where the warm cooling water from the condenser is brought into direct contact with the relative dry air. The Synergy Sdn Bhd used cooling tower for water cooling at water flow rate of 100 kg/s from 40 °C to 33 °C. Ambient air is at 30°C, 93 kPa and 50%RH. Assuming that the air reaches thermodynamic equilibrium with incoming water, calculate:

i. Air mass flow rate needed
ii. Heat Dissipation

(7 marks)

(d) The refrigeration cycle begins with the refrigerant in the evaporator. When leaving the evaporator, the refrigerant has absorbed a quantity of heat from the product and is a low-pressure, low-temperature vapour. Discuss suitable methods in maintaining the refrigerant operation for optimum energy efficiency.

(5 marks)

Q5 (a) Steam is a principle energy source for chemical industrial processes. It provides energy for process heating, pressure control, mechanical drives, and component separation. Describe the mechanical functions for *strainers* and *insulator* used in steam and condensate system.

(5 marks)

(b) There are many practical and proven methods for energy efficiency measure for steam system, and it is important to choose the ones appropriate. Discuss the *proper ways* in maintaining the steam system for optimum efficiency.

(7 marks)

(c) Today in a world of global competition, increasing power costs, economic expansion and environmental concerns, many industries are turning to cogeneration such as shown in **Figure Q5 (c)**. Through the utilization of the heat, the efficiency of a cogeneration plant can reach 90% or more. State three *important aspects* in waste heat management and *principle* of cogeneration.

(8 marks)

(d) The main function of an electrical power distribution system is to provide power to individual consumer premises. Distribution of electric power to different consumers is done with much low voltage level. List the main part of distribution network exist in electrical distribution system.

(5 marks)

- END OF QUESTION –

FINAL EXAMINATION

SEMESTER/SESSION : SEM 1 2016/2017 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE : BNL 40303

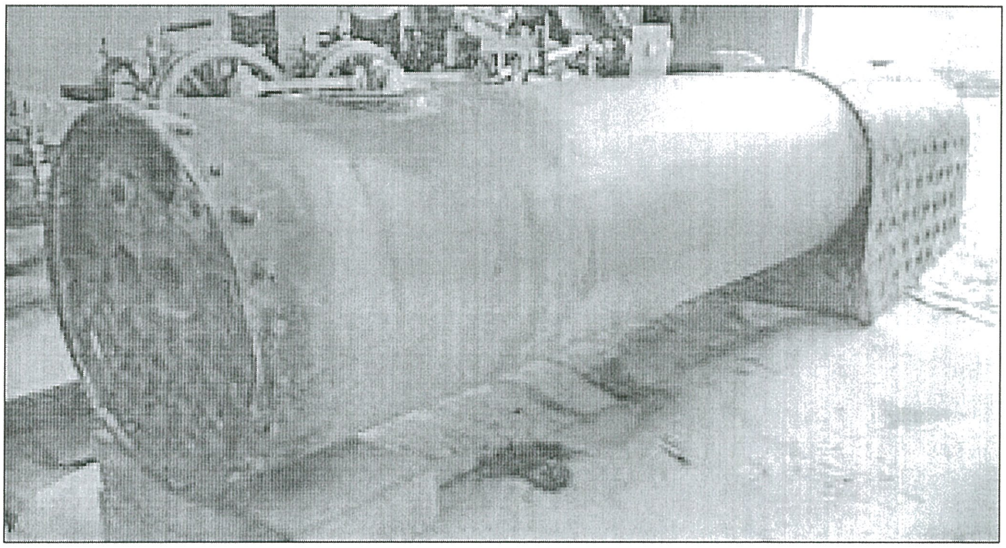


Figure Q1 (c): Boiler Failure Operation

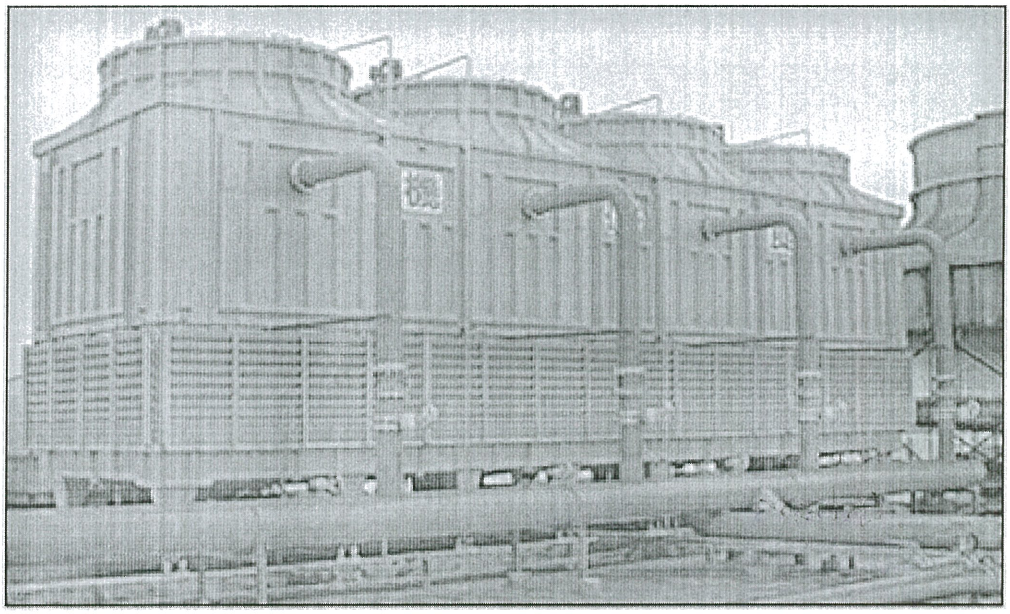
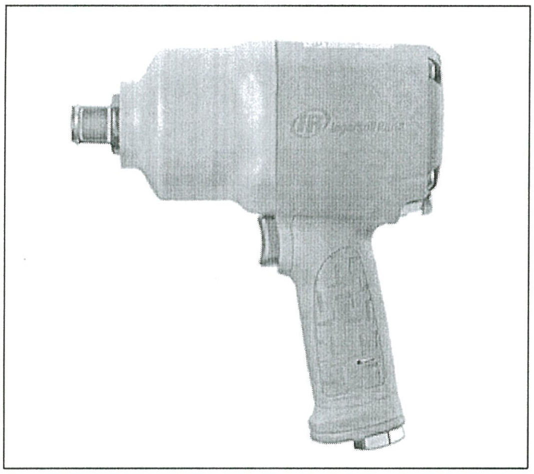


Figure Q4 (a): Cooling Tower System

FINAL EXAMINATION

SEMESTER/SESSION: SEM 1 2016/2017 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE: BNL 40403



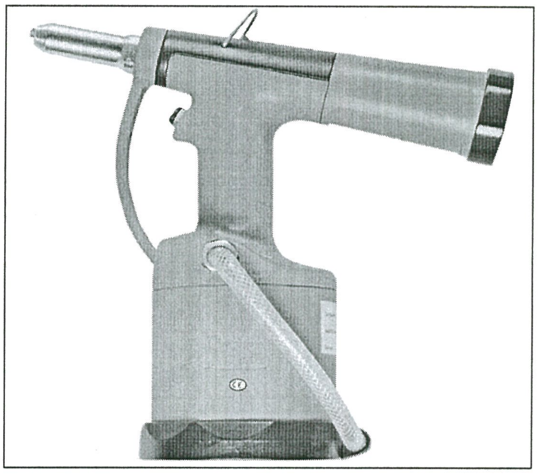


Figure 4(c): Air power tool and hydraulic power tool

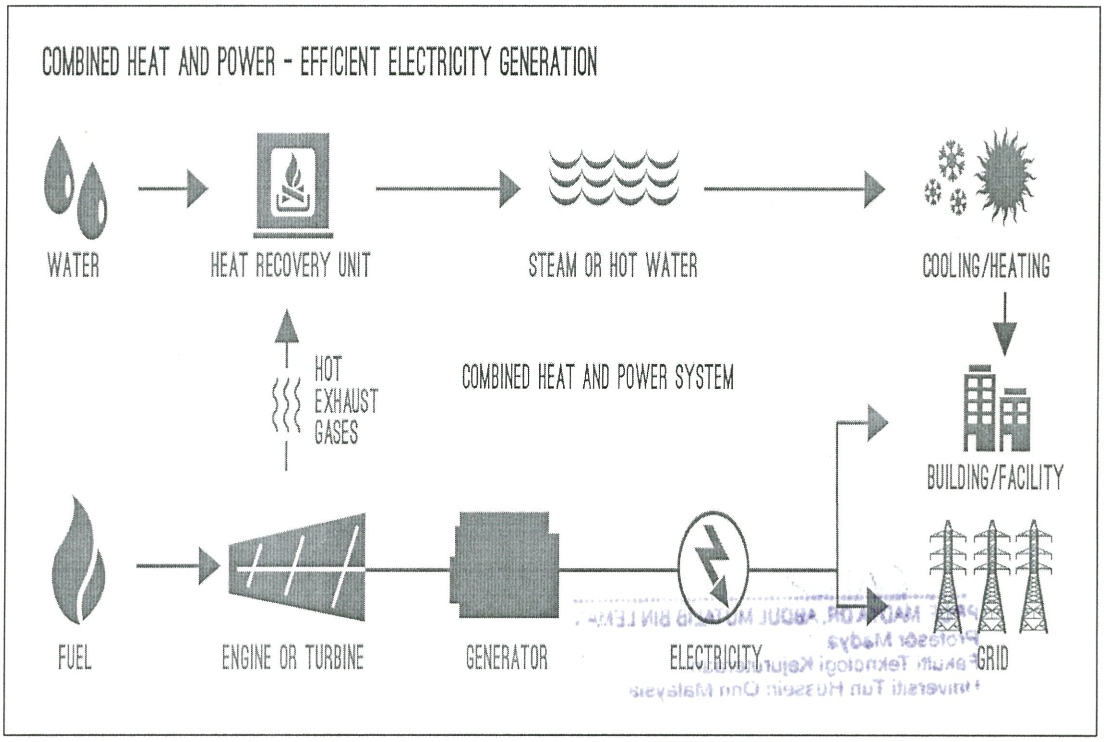


Figure Q5 (c): Cogeneration System