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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016**

COURSE NAME : PLANT ENERGY EFFICIENCY
COURSE CODE : BNL 40303
PROGRAMME : 4 BNL
EXAMINATION DATE : DECEMBER 2015/JANUARY 2016
DURATION : 3 HOURS
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

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- Q1**
- (a) Energy issues are public concern;
- (i) Explains what "energy management" and it's important. (3 marks)
- (ii) Identify **Four (4)** steps towards energy-management process. (4 marks)
- (b) Energy plays a key role in the development and growth economy. Therefore, the availability of adequate supplies of energy is a strategic issue for any country including Malaysia. Discuss the roles of the plant technologist in energy management to ensure its success. (8 marks)
- (c) The energy hierarchy is a simple principle for prioritizing solutions; a sensible energy policy should make its first priority the reduction of energy use before seeking to meet demand by the cleanest means possible. Please identify the hierarchy from unsustainable to sustainable energy. (10 marks)
- Q2**
- (a) Investment decision making is very important before involved with the energy economic. Please explain:
- (i) Single Payment Compound Amount- F/P; and
- (ii) Single Payment Presents Worth- P/F. (6 marks)
- (b) An evaluation needs to be made to replace 40-watt fluorescent lamp with a new lamp that saves 12% or 4.8 watts and gives the same output. The cost of each lamp is RM 4.80. Hours of operation are 4800 and the lamp life is two years. Electricity cost 70 cent/ kWh. Assuming a rate of return before taxes of 25% are required, can the immediate replacement be justified? (6 marks)
- (c) The total bill for the month is RM 450,000 and the power factor (PF) is 0.8.
- (i) Calculate the monthly penalty, which TNB charges you the low PF.
- (ii) How much would be monthly PF penalty if PF was 0.7 instead of 0.8. (6 marks)
- (d) The torque developed on the shaft of a 10 kW electric motor at a speed of 1450 r.p.m is 25.5 Nm. Calculate the motor shaft power (kW), loading factor and the efficiency of the motor at this loading condition if a kilowatt meter shows that the motor demand is 5.16 kW (7 marks)

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- 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)

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For the following questions please refer to Appendix A and B

- Q4** (a) The energy usage of one family in urban areas is 348 kWh per month.
- (i) Calculate the energy bill by applying the previous tariff;
 - (ii) Calculate the energy bill by applying the current tariff;
 - (iii) Calculate the percentage increase.
- (7 marks)
- (b) The energy usage of commercial building is 450 kWh per month
- (i) Calculate the energy bill by applying the previous tariff;
 - (ii) Calculate the energy bill by applying the current tariff;
 - (iii) Calculate the percentage increase.
- (7 marks)
- (c) The energy usage of one company (small and medium industries) is 600 kWh.
- (i) Calculate the energy bill by applying the previous tariff;
 - (ii) Calculate the energy bill by applying the current tariff;
 - (iii) Calculate the percentage increase
- (6 marks)
- (d) Discuss the percentage increase on (a), (b) and (c) and give the idea how to reduce the energy consumptions.
- (5 marks)

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For the following questions please refer to Appendix A and B

- Q5 (a)** Determine the energy bill if the electric appliances usage for domestic Consumer is based on **Table Q5 (a)** below.

Table Q5 (a): Electrical appliances with power input in watt and total usage per day.

Living Room	Fluorescent lamp 1	fluorescent lamp 2	Ceiling Fan	Refrigerator
	36 (6)	36 (4)	75 (8)	85 (24)
Bed Room	Fluorescent lamp 1	Fluorescent lamp 2 (toilet)	Ceiling Fan	Air-conditioning
	36 (4)	36 (9)	75 (8)	700 (8)
Bed Room	Fluorescent lamp 1	Ceiling Fan	Table fan	Laptop
	36 (6)	75 (8)	75 (3)	90 (3)
Bed Room	Fluorescent lamp 1	Ceiling Fan	Table Fan	Laptop
	36(6)	75 (6)	75 (2)	90 (3)
Kitchen	Fluorescent lamp 1	Electric Kettle	Internet Modem	Washing Machine
	36 (6)	2200 (1)	12 (8)	200 (2)

After calculating the energy bill, please give an option how energy saving approach could be implemented and what are the activity that should be taken.

(10 marks)

- (b) Determine the energy bill if the electric appliances usage for industrial consumer is based on **Table Q5 (b)** below.

Table Q5(b): Electrical appliances with power input in watt and total usage per day.

Zon 1(Office)	Fluorescent lamp 1	fluorescent lamp 2	Computer	Air-Conditioning	Refrigerator
	36 (9)	36 (9)	75 (8)	700 (8)	85(24)
Zon 2 (line)	Fluorescent lamp 1	Fluorescent lamp 2 (toilet)	Industrial Fan	Air-conditioning	Soldering A
	36 (8)	36 (2)	100 (8)	700 (8)	1200(7)
Zon 3 (line)	Fluorescent lamp 1	Industrial Fan	Soldering B	Dryer	Conveyor Motor
	36 (8)	100 (8)	1200 (6)	280 (6)	200 (7)
Zon 4 (line)	Fluorescent lamp 1	Compressor	Industrial Fan	Computer (labeling)	Conveyor Motor
	36(8)	300(6)	100 (3)	90 (3)	200(7)
Zon 5 (store)	Fluorescent lamp 1	Electric Kettle	Internet Modem	Packaging Machine	Motor (AGV)
	36 (8)	2200 (2)	12 (8)	400 (7)	700 (4)

After calculating the energy bill, please give an option how energy saving approach could be implemented and what are the activity that should be taken.

(15 marks)

- END OF QUESTION -

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APPENDIX A (2011 Tariff)

Tariff Rates

“Domestic Consumer” means a consumer occupying a private dwelling, which is not used as a hotel, boarding house or used for the purpose of carrying out any form of business, trade, professional activities or services.

	TARIFF CATEGORY	UNIT	RATES
	Tariff A - Domestic Tariff		
	For the first 200 kWh (1 - 200 kWh) per month	sen/kWh	21.8
	For the next 100 kWh (201 - 300 kWh) per month	sen/kWh	33.4
	For the next 100 kWh (301 - 400 kWh) per month	sen/kWh	40.0
	For the first 100kWh (401 - 500 kWh) per month	sen/kWh	40.2
1.	For the next 100 kWh (501 - 600 kWh) per month	sen/kWh	41.6
	For the next 100 kWh (601 - 700 kWh) per month	sen/kWh	42.6
	For the next 100 kWh (701 - 800 kWh) per month	sen/kWh	43.7
	For the next 100 kWh (801 - 900 kWh) per month	sen/kWh	45.3
	For the next kWh (901 kWh onwards) per month	sen/kWh	45.4
	<i>The minimum monthly charge is RM3.00</i>		

	TARIFF CATEGORY	UNIT	RATES
	Tariff B - Low Voltage Commercial Tariff		
	For Overall Monthly Consumption Between 0-200 kWh/month		
	For all kWh	sen/kWh	39.3
1.	<i>The minimum monthly charge is RM7.20</i>		
	For Overall Monthly Consumption More Than 200 kWh/month		
	For all kWh (From 1kWh onwards)	sen/kWh	43.0
	<i>The minimum monthly charge is RM7.20</i>		
2.	Tariff C1 - Medium Voltage General Commercial Tariff		
	For each kilowatt of maximum demand per month	RM/kW	25.9
	For all kWh	sen/kWh	31.2
	<i>The minimum monthly charge is RM600.00</i>		
3.	Tariff C2 - Medium Voltage Peak/Off-Peak Commercial Tariff		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	38.60
	For all kWh during the peak period	sen/kWh	31.2
	For all kWh during the off-peak period	sen/kWh	19.2
	<i>The minimum monthly charge is RM600.00</i>		

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Industrial

	TARIFF CATEGORY	UNIT	RATES
	Tariff D - Low Voltage Industrial Tariff		
	For Overall Monthly Consumption Between 0-200 kWh/month		
	For all kWh	sen/kWh	34.5
	<i>The minimum monthly charge is RM7.20</i>		
1.	For Overall Monthly Consumption More Than 200 kWh/month		
	For all kWh (From 1kWh onwards)	sen/kWh	37.7
	<i>The minimum monthly charge is RM7.20</i>		
	Tariff Ds – Special Industrial Tariff (for consumers who qualify only)		
	For all kWh	sen/kWh	35.9
	<i>The minimum monthly charge is RM7.20</i>		
2.	Tariff E1 - Medium Voltage General Industrial Tariff		
	For each kilowatt of maximum demand per month	RM/kW	25.3
	For all kWh	sen/kWh	28.8
	<i>The minimum monthly charge is RM600.00</i>		
	Tariff E1s – Special Industrial Tariff (for consumers who qualify only)		
	For each kilowatt of maximum demand per month	RM/kW	19.9
	For all kWh	sen/kWh	28.3
	<i>The minimum monthly charge is RM600.00</i>		
3.	Tariff E2 - Medium Voltage Peak/Off-Peak Industrial Tariff		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	31.7
	For all kWh during the peak period	sen/kWh	30.4
	For all kWh during the off-peak period	sen/kWh	18.7
	<i>The minimum monthly charge is RM600.00</i>		
	Tariff E2s – Special Industrial Tariff (for consumers who qualify only)		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	27.7
	For all kWh during the peak period	sen/kWh	28.3
	For all kWh during the off-peak period	sen/kWh	16.1
	<i>The minimum monthly charge is RM600.00</i>		
4.	Tariff E3 - High Voltage Peak/Off-Peak Industrial Tariff		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	30.4
	For all kWh during the peak period	sen/kWh	28.8
	For all kWh during the off-peak period	sen/kWh	17.3

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Tariff Rates

(APPENDIX B 2014 TARIFF)

“Domestic Consumer” means a consumer occupying a private dwelling, which is not used as a hotel, boarding house or used for the purpose of carrying out any form of business, trade, professional activities or services.

TARIFF CATEGORY		UNIT	RATES
Tariff A - Domestic Tariff			
1.	For the first 200 kWh (1 - 200 kWh) per month	sen/kWh	21.80
	For the next 100 kWh (201 - 300 kWh) per month	sen/kWh	33.40
	For the next 100 kWh (301 - 600 kWh) per month	sen/kWh	51.60
	For the first 100kWh (601 - 900 kWh) per month	sen/kWh	54.60
	For the next 100 kWh (901 kWh onwards) per month	sen/kWh	57.10
<i>The minimum monthly charge is RM3.00</i>			
TARIFF CATEGORY		UNIT	RATES
Tariff B - Low Voltage Commercial Tariff			
1.	For the first 200 kWh (1-200 kWh) per month	sen/kWh	43.5
	For the next kWh (201 kWh onwards) per month	sen/kWh	50.9
	<i>The minimum monthly charge is RM7.20</i>		
Tariff C1 - Medium Voltage General Commercial Tariff			
2.	For each kilowatt of maximum demand per month	RM/kW	30.3
	For all kWh	sen/kWh	36.5
	<i>The minimum monthly charge is RM600.00</i>		
Tariff C2 - Medium Voltage Peak/Off-Peak Commercial Tariff			
3.	For each kilowatt of maximum demand per month during the peak period	RM/kW	45.10
	For all kWh during the peak period	sen/kWh	36.5
	For all kWh during the off-peak period	sen/kWh	22.4
	<i>The minimum monthly charge is RM600.00</i>		

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	TARIFF CATEGORY	UNIT	RATES
1.	Tariff D – Low Voltage Industrial Tariff		
	For the first 200 kWh (1-200 kWh) per month	sen/kWh	38.00
	For the next kWh (201 kWh onwards) per month	sen/kWh	44.10
	<i>The minimum monthly charge is RM7.20</i>		
	Tariff Ds – Special Industrial Tariff (for consumers who qualify only)		
	For all kWh	sen/kWh	42.70
	<i>The minimum monthly charge is RM7.20</i>		
2.	Tariff E1 – Medium Voltage General Industrial Tariff		
	For each kilowatt of maximum demand per month	RM/kW	29.60
	For all kWh	sen/kWh	33.70
	<i>The minimum monthly charge is RM600.00</i>		
	Tariff E1s – Special Industrial Tariff (for consumers who qualify only)		
	For each kilowatt of maximum demand per month	RM/kW	23.70
	For all kWh	sen/kWh	33.60
	<i>The minimum monthly charge is RM600.00</i>		
	Tariff E2 – Medium Voltage Peak/Off-Peak Industrial Tariff		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	37.00
For all kWh during the peak period	sen/kWh	35.50	
For all kWh during the off-peak period	sen/kWh	21.90	
<i>The minimum monthly charge is RM600.00</i>			
3.	Tariff E2s – Special Industrial Tariff (for consumers who qualify only)		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	32.90
	For all kWh during the peak period	sen/kWh	33.60
	For all kWh during the off-peak period	sen/kWh	19.10
	<i>The minimum monthly charge is RM600.00</i>		
4.	Tariff E3 – High Voltage Peak/Off-Peak Industrial Tariff		
	For each kilowatt of maximum demand per month during the peak period	RM/kW	35.50
	For all kWh during the peak period	sen/kWh	33.70
	For all kWh during the off-peak period	sen/kWh	20.20
	<i>The minimum monthly charge is RM600.00</i>		

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