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# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

# FINAL EXAMINATION SEMESTER II SESI 2011/2012

COURSE NAME	:	ENERGY SAVING AND MANAGEMENT
CODE NAME	•	BDE 4023
PROGRAMME	•	4 BDD
EXAMINATION DATE	:	JANUARY 2012
DURATION	•	3 HOURS
INSTRUCTION	:	ANSWER FOUR (4) QUESTIONS ONLY

THIS PAPER CONTAINS NINE (9) PRINTED PAGES

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- Q1 (a) Energy issues are public concern;
  - (i) Explains what "energy management", and it's important;
  - (ii) Identify four steps towards energy-management process.

(7 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. What are the roles of the plant engineer 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 the, 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 rpm is 25.5 Nm. Calculate the motor shaft power (kW), loading factor and the efficiency of the motor at this loading conditions, if a kilowatt meter shows that the motor demand is 5.16 kW.

(7 marks)

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 leakage. The following measurements have been collected for a typical compressor load cycle;

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

The current for the 3 phase's measurement:

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 the compressor load (kW);

ii) Calculate the compressor average load (kW) during production period;

iii) Estimate the compressor power during the leak test;

iv) Estimate energy and cost due to leaks; and

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

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- 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) Please calculate the energy bill if the electric appliances usage for domestic Consumer is based on Table 1 below.

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

Table 1: Electrical appliances with power input in watt and total usage per day.

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) Please calculate the energy bill if the electric appliances usage for industrial consumer is based on Table 2 below.

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

# **Tariff Rates**

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"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		RATI	ES
1.	Tariff A - Domestic Tariff						
	For Monthly Consumption Between 0-400 i	(Wh/month					
:	For the first 200 kWh (1 - 200 kWh) per month			sen/kWh		21.8	3
	For the next 200 kWh (201 -400 kWh) per mon	th		sen/kWh	an a	33.4	<b>1</b>
	The minimum monthly charge is RM3.00			· · · · · · · · · · · · · · · · · · ·	· · · ·		
	For Monthly Consumption More Than 400 k	Wh/month					
	For the first 500kWh (1-500kWh) per month			sen/kWh		28,6	5
	For the next 100 kWh (501-600kWh) per mont	ni sanan Sanan An din sa		sen/kWh		37.8	- 2020 - 2020 3
	For the peyt 100 kWh (601-700kWh) per month	ili gi		sen/kWb		38.	,
	For the pert 100 kWh (701-800kWh) per month	n. Lintere Littere di		sen/kWh		30	7
	For the part ion lub (ont photos) are month			con/kWb			
	For the next too kwn (out-source) ber month			Senzkwit	·		-
: • . •	For the next kwn (901 kwn onwards) per mont	an Alatan		sen/kwn	1.1 T	44.0	0
	The minimum monthly charge is RM3.00			·			
	TARIFF CATEG	ORY				UNIT	RATES
1.	Tariff B - Low Voltage Commercial Tariff	andraa See	: .				
	For Overall Monthly Consumption Betwe	en 0-200 kW	/h/month		a Maratan Sana Basa Basa	en e	
	For all kwh				······································	sen/kWh	37.0
	The minimum monthly charge is RM7.20	aataa ah a					
	For Overall Monthly Consumption More 1	rhan 200 kW	/h/month				
	For all kWh (From 1kWh onwards)					sen/kWh	39.7
	The minimum monthly charge is RM7.20		«				
2,	Tariff C1 - Medium Voltage General Com	mercial Tari	<b>11</b>			tanan Tanàna taona 1	
	For each kilowatt of maximum demand per n	nonth				RM/kW	23.93
	For all kWh		in diam. Te			sen/kWh	28.8
	The minimum monthly charge is RM600.00	précession de la composition de la composition de la composition		· · ·	ana an		
3.	Tariff C2 - Medium Voltage Peak/Off-Pe	ak Commerc	ial Tariff	e en esta da La consta da	e u sel Aurope e com gen la la		
	For each kilowatt of maximum demand per n	nonth during	the peak peri	od	 	RM/kW	35.60
	For all kWh during the peak period	in the second				sen/kWh	28.8
	and a second	e let Se Vingen e e com	and Anarasia (S. 1999)		li Ageneration de la composición de la com	tanitin,	
	For all kWh during the off-peak period				iationalia. Mari	sen/kWh	17.7
	The minimum monthly charge is RM600.00		· · · ·			-	

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	TARIFF CATEGORY			ŲN	IT	RATES
Tariff D - Low Volta	ge Industrial Tariff		4		1911 - L	
For Overall Monthly	Consumption Betwee	n 0-200 kWh	/month			
For all kWh				sen/l	(Wh	32.5
The minimum monthly	y charge is RM7,20				na na migrita. Na la composition	
For Overall Monthly	Consumption More Th	an 200 kWh	/month			
For all kWh (From 1k)	Wh.onwards)	t g		sen/	cWh	34.8
The minimum monthl	y charge is RM7.20					and the second sec
Tariff Ds – Special I	Industrial Tariff (for co	nsumers wh	o qualify only	,	stra≑ , s	
For all kWh				sen/	¢Wh	32.7
The minimum month	v charne ic PM7 20				n Belen in Fr	
jariff E1 - Medium	voltage General Indus					04 66
For each kilowatt of n	naximum demand per mo	אתנח	i Basta Brennin	КМ	K VV:	23.40
For all kWh				sen/	kWh	26.6
The minimum month	y charge Is RM600.00		to presente provide to to presente to to presente to to presente to			a an
Tariff E1s - Special	Industrial Tariff (for c	onsumers w	no quality on	iły) (biologia) statu i		
For each kilowatt of n	naximum demand per mo	onth		RM	'kW	18.10
For all kWh				sen/	kWh	25.8
The minimum monthl	ly charge is RM600.00		•	·		
Tariff E2 - Medium	Voltage Peak/Off-Peal	k Industrial '	Tariff			
For each kilowatt of r	naximum demand per mo	onth during th	ie peak period	RM	′kW	29.30
For all kWh during th	e peak period	i I.A.	•	sen/	<b>k</b> ₩h.	28.1
For all kWh during th	e off-peak period			sen/	k₩h	17.3
The minimum month	ly charge is RM600.00	a y nangan ay ilan il	e e subputs a a A a statistica a a		ndahara.	
Tariff E2s - Special	Industrial Tariff (for	consumers v	vho qualify or	nly)		
For each kilowatt of s	naximum demand per m	onth during th	ne peak period	RM	/kW	25.20
For all kWb during th	e peak period		to a state of the	sen	'kWh	25.8
Tot all Kivit during th	e pear period	n ang sang sang sang sang sang sang sang		con	(FWF	14.7
				jeri)	Kutu	t in the second s
The minimum month	ly charge is RM600.00		.:			
Tariff E3 - High Vol	itage Peak/Off-Peak II	ncustrial Tar	<b>167</b> - Constanting - Constanting (Constanting) - Constanting (Constanting)	i di Hatila proto Hatila Proto		i i i i i i i i i i i i i i i i i i i
For each kilowatt of	maximum demand per m	onth during t	he peak period	RM	/kW	28.10
For all kWh during th	ne peak period		e E E	sen	/kWh	26.6
For all kWh during th	ne off-peak period			sen	/kWh	16.0
The minimum month	ly charge is RM600.00					

## **Tariff** Rates

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"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				
19 10 10 10 10 10 10 10 10 10 10 10 10 10	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				
_	The minimum monthly charge is RM3.00						

	TARIFF CATEGORY	UNIT	RATES					
1	Tariff B - Low Voltage Commercial Tariff							
	For Overall Monthly Consumption Between 0-200 kWh/month							
	For all kWh	sen/kWh	39,3					
1.	The minimum monthly charge is RM7.20							
	For Overall Monthly Consumption More Than 200 kWh/month							
	For all kWh (From 1kWh onwards)	sen/kWh	43.0					
	The minimum monthly charge is RM7.20							
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					
	The minimum monthly charge is RM600.00							
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					
	The minimum monthly charge is RM600.00							

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	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					
	The minimum monthly charge is RM7.20		77-1100 0 1100 0 100 0 10 10 10 10 10 10 10					
1	For Overall Monthly Consumption More Than 200 kWh/month							
1,	For all kWh (From 1kWh onwards)	sen/kWh	37.7					
	The minimum monthly charge is RM7.20							
	Tariff Ds – Special Industrial Tariff (for consumers who qualify only)							
	For all kWh	sen/kWh	35.9					
	The minimum monthly charge is RM7.20							
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					
	The minimum monthly charge is RM600.00							
	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					
	The minimum monthly charge is RM600.00							
	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					
2	The minimum monthly charge is RM600.00							
э.	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					
	The minimum monthly charge is RM600.00							
	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					
4.	For all kWh during the peak period	sen/kWh	28.8					
	For all kWh during the off-peak period	sen/kWh	17.3					
	The minimum monthly charge is RM600.00							