Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	PLANT ENERGY EFFICIENCY
COURSE CODE	:	BNL 40303
PROGRAMME CODE	:	BNL
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1

(a) (i) One of the important components of energy management is to conduct energy audit to evaluate energy consumption in a premise. Briefly discussed **THREE (3)** levels of energy audit commonly practiced in industry.

(7 marks)

(ii) Briefly sketch and explain the "circular process" of energy management in terms of managerial and technical.

(8 marks)

(b) Energy management is the systematic use of management and technology to improve an organization's energy performance. It is a practice of using energy more efficiently by eliminating energy waste. In your own words, explain the purpose of having energy management program.

(5 marks)

(c) Tariff is the methods of charging a consumer for consuming electric power. The tariff covers the total cost of producing and supplying electric energy plus a reasonable cost. As plant energy engineer, suggest good actions to reduce electric utility costs.

(5 marks)

Q2

(a) Many and various types of boilers have been developed beginning with the simple cylindrical shell types boiler to outer surfaces. State **THREE (3)** types of boilers and explain the operating principle of all boilers.

(10 marks)

(b) In steam heating systems water is heated to its boiling point 100°C (212°F) and steam rises by convection through pipes to heat exchangers (radiators) located throughout the building, displacing the air in the pipes and radiators. List the efficiency factors that affect the usage of steam system.

(5 marks)

(c) A room in commercial buildings is 90 feet x 250 feet. It will use 300 fluorescent lighting units that draw 3 amperes each. Also, 20-ampere branch circuit will be used. The power factor of the units is 0.75. The operating voltage is 180 volts. Find:

(i) The total current drawn by the lights

(ii) Total power

(5 marks)

(d) Investment decision making is very important before involve with energy economic. Please explain:

(i) Single Payment Compound Amount- F/P; and

(ii) Single Payment Presents Worth- P/F.

(5 marks)

Q3

(a) Steam is used for generating power and also used in process industries such as sugar, paper, fertilizer, refineries, petrochemicals, chemical, food, synthetic fibre and textiles. **Figure Q3 (a)** shows the steam and condensate system. Discuss the flow in the steam distribution system.

(5 marks)

(b) An efficient steam distribution system is essential if steam of the right quality and pressure is to be supplied, in the right quantity, to the steam using equipment. Explain the function of the components below:

(i). Steam traps
(ii). Strainers
(iii). Separators
(iv). Filters
(v). Insulators

(10 marks)

(c) Boilers can be designed for maximum efficiency but it takes a tremendous effort to operate and sustain efficiency over a long period of time. Calculate the amount of heat loss through radiative and convective loss from the 275°F surface of a boiler into a room whose temperature is 93°F. The exposed surface of the boiler is 530 ft^2.

(5 marks)

(d) A cooling tower is a heat rejection device that rejects waste heat to the atmosphere through the cooling of a water stream to a lower temperature. The heat transfer rate depends on maximizing the contact area between the water, air and the length of time. Explain briefly the properties of Mechanical Draft and Natural Draft Hyperbolic cooling tower.

(5 marks)

Please refer to the Appendix A, Appendix B and Appendix C for the following questions.

Q4

(a) The monthly usage of energy for one family in urban area was 365 kWh.

(i) Calculate the energy bill by applying previous tariff
(ii) Calculate the energy bill by applying current tariff
(iii) Calculate the percentage of increase between previous and current tariff

(7 marks)

(b) The monthly usage of energy for commercial building in urban area was 480 kWh.

(i). Calculate the energy bill by applying previous tariff
(ii). Calculate the energy bill by applying current tariff
(iii). Calculate the percentage of increase between previous and current tariff

(7 marks)

(c) The monthly usage of energy for small and medium industry was 630 kWh.

(i). Calculate the energy bill by applying previous tariff
(ii). Calculate the energy bill by applying current tariff
(iii). Calculate the percentage of increase between previous and current tariff

(7 marks)

(e) Discuss the percentage increase on **Q4 (a), (b)** and **(c)** and give the suggestions on how to handle the energy consumptions.

(4 marks)

Q5

(a) A refrigeration system is a combination of components and equipment connected in a sequential order to produce the desired refrigeration effect (cooling or heating). Describe the operation of open and closed air refrigeration system. State the advantages and disadvantages of the system.

(8 marks)

(b) A properly managed supply side will result in clean, dry, stable air being delivered at the appropriate pressure in a dependable, cost-effective manner. A properly managed demand side minimizes wasted air and uses compressed air for appropriate applications. Explain about the significance of pressure settings of a compressed air network.

(4 marks)

(c) An air compressor is rated at 25 m^3/s FAD. Calculate the flow rate in the air piping network if the pressure is 7 bar (gauge) with temperature of 30°C.

(5 marks)

(d) An ammonia refrigerating machine fitted with an expansion valve works between the temperature limits of -10°C and 30°C. The vapor is 95% dry at the end of isentropic compression and fluid leaving the condenser is at 30°C. Assuming actual C.O.P. as 60% of the theoretical, calculate the actual C.O.P. Refer **Table Q5 (d)** for the properties of the ammonia refrigerating machine.

(8 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2018/2019 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE: BNL 40303

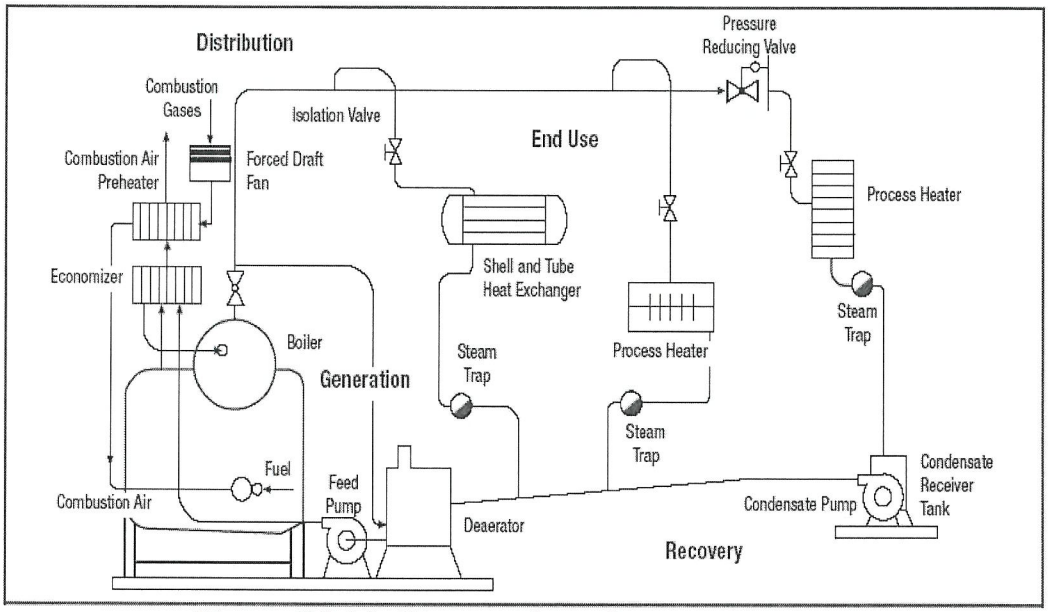

Figure Q3 (a): Steam and condensate system

Table Q5 (d): Properties of ammonia

Temperature (°C)	Liquid heat (hf), kJ/kg	Latent heat (hfg), kJ/kg	Liquid entropy (sf)	Total entropy dry saturated vapour)
30	323.08	1145.80	1.2037	4.9842
-10	135.37	1297.68	0.5443	5.4770

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2018/2019 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE: BNL 40303

APPENDIX A (TARIFF 2011)

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
1.	**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
	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
	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
	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		

FINAL EXAMINATION

SEMESTER/SESSION : SEM I /2018/2019 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE: BNL 40303

Industrial

	TARIFF CATEGORY	UNIT	RATES
1.	**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		
	For Overall Monthly Consumption More Than 200 kWh/month		
	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		
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
	The minimum monthly charge is RM600.00		
	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		
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

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2018/2019 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE: BNL 40303

Tariff Rates APPENDIX B (TARIFF 2014)

"**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 service

	TARIFF CATEGORY	UNIT	RATES
1.	**Tariff A - Domestic Tariff**		
	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
	The minimum monthly charge is RM3.00		

	TARIFF CATEGORY	UNIT	RATES
1.	**Tariff B - Low Voltage Commercial Tariff**		
	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
	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	30.3
	For all kWh	sen/kWh	36.5
	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	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
	The minimum monthly charge is RM600.00		

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2018/2019 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE: BNL 40303

	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
	The minimum monthly charge is RM7.20		
	Tariff Ds – Special Industrial Tariff (for consumers who qualify only)		
	For all kWh	sen/kWh	42.70
	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	29.60
	For all kWh	sen/kWh	33.70
	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	23.70
	For all kWh	sen/kWh	33.60
	The minimum monthly charge is RM600.00		
3.	**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
	The minimum monthly charge is RM600.00		
	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
	The minimum monthly charge is RM600.00		
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
	The minimum monthly charge is RM600.00		

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2018/2019 PROGRAMME : BNL
COURSE NAME : PLANT ENERGY EFFICIENCY COURSE CODE: BNL 40303

Tariff Rates APPENDIX C (TARIFF 2018)

	TARIFF CATEGORY	UNIT	CURRENT RATE (1 JAN 2018)
	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 300 kWh (301 - 600 kWh) per month	sen/kWh	51.60
	For the next 300 kWh (601 - 900 kWh) per month	sen/kWh	54.60
	For the next kWh (901 kWh onwards) per month	sen/kWh	57.10
	The minimum monthly charge is RM3.00		