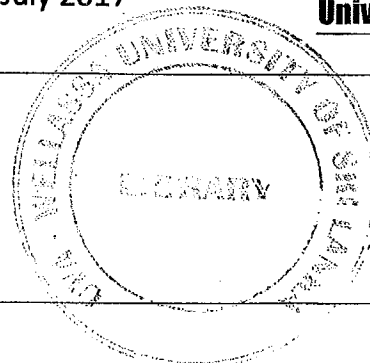


Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 level 1st Semester Examination –June/July 2017
SCT 308-2 Energy Technology



Instructions to candidates

Duration: Two (02) hours

Number of questions: Three (03) Essays

Mark allocation: 100

Answer All (03) questions

1. Super luxury housing complex situated in central Colombo consists of 34 stories and has 110 apartments of different categories and sizes. The complex uses an in-house transformer of capacity 1500 kVA to convert high voltage power from CEB to 240V electricity. The energy manager was asked to conduct an energy audit for this housing complex. As part of the energy audit, an effort was made to calculate the efficiency of the transformer with the available resources and data. The energy input to the transformer and the energy output from the transformer for a particular time period was measured. The energy input to the transformer was obtained from the CEB meter reading. The energy output was calculated from the power analyzer curve for the same time period.

The following data were recorded during the time period of 2 days (48 hours)
Electricity consumption from the CEB meter reading (input): 5910 kWh
Electricity consumption from the power analyzer curve (output): 5605.45 kWh

Based on these measurements and the additional data given below,

- a. Calculate the efficiency of the transformer and comment on your answer (15 marks)
- b. Calculate the increase in electricity consumption due to the transformer loss (10 marks)
- c. Calculate the increase in maximum demand due to the transformer loss (15 marks)
- d. The audit team advised the management to consider the following two options
Option 1
Use a highly efficient transformer with an efficiency of 98.5%
Option 2
Use the tariff system GP2 instead of the presently used tariff system of GP3. Note that, when GP2 is used, CEB charges only after the transformer and hence no need for considering the transformer losses

Using the given data and additional information in "Table 01", fill in the blank spaces in "Table 01".

(40 marks)

- e. What is your recommendation to the management of this building complex

Give reasons for your answer

(20 marks)

Additional data

Efficiency = (output/ input) *100%

Average monthly (30 days) electricity consumption of the building is 88650 kWh and the maximum electricity demand is 219 kVA

Housing complex has a constant electricity demand throughout the day

Table 01

	Current Transformer and current tariff system	New Transformer with current tariff system	Switch to GP2 tariff system
Transformer efficiency	Use answer for (i)	98.5%	Not applicable
Average monthly electricity consumption (kWh)	88650		
Unit charges (Rs.)	13.60	13.60	13.80
Monthly cost of electricity consumption (Rs.)			
Fixed charge (Rs.)	3,000.00	3,000.00	3,000.00
Average maximum demand (kVA)	219		
Demand charge/ unit (Rs.)	675.00	675.00	675.00
Demand Cost (Rs.)			
Total cost			

2. a. What are the three mechanisms of heat transfer and briefly explain one mechanism

(20 marks)

- b. An insulated pipe carrying wet steam at 300 °C has an internal diameter of 33.5 mm, a wall thickness of 3.4 mm, and an insulation thickness of 25 mm. The thermal conductivity is as follows

Material	Thermal Conductivity
Pipe material	50 W/mK
Insulating material	0.03 W/mK

Ambient temperature 24 °C

Thermal resistance of a cylinder $R = \ln\left(\frac{r_2}{r_1}\right) / 2 \pi K$

The inside and outside surface heat transfer coefficients are 10,000 W/m² K and 10 W/m² K, calculate,

The steady-state rate of heat transfer per unit length of pipe (40 marks)

- c. Explain briefly the benefits of having a good insulation for a boiler (15 marks)
- d. What is an energy audit (10 marks)
- e. What are the basic rules for achieving energy efficiency in lighting (15 marks)

3. a. List out five renewable energy sources and describe five advantages when using renewable energy sources for energy generation (30 marks)
- b. Discuss the current situation of national electricity supply and demand, and future trends of electricity generation in Sri Lanka (20 marks)
- c. What is meant by 'run off the river type mini hydro power plant' and explain why it is considered as a renewable energy solution (10 marks)
- d. Briefly explain all the components of a typical 'run off the river type mini hydro power plant' mentioning salient features of each component (20 marks)
- e. Briefly discuss the current solar energy technologies used in electricity generation and other energy applications mentioning their issues and limitations (20 marks)

