NATIONAL UNIVERSITY OF SINGAPORE

Department of Electrical Engineering

EE2022 ELECTRICAL ENERY SYSTEMS

(Tutorial #8)

1. A small industry operating night and day, 7 days/week, consumes 260,000 kWh/month. The maximum demand is 1530 kW. Calculate the electricity bill for this customer using the rate schedule shown below.

Demand charge	$3.00 per month per kW of billing demand
Energy charge	$0.04/kWh for the first 100 hours of billing demand
	$0.02/kWh for the next 50,000 kWh/month
	$0.012/kWh for the remaining energy

Solution: Applying the rate schedule, the demand charge = 1530 x $3.00 = $ 4590

Energy charge for the first 100 hours = 1530 kW x 100 h x $0.04 = 153,000 x 0.04 = $ 6120
The energy charge for the next 50,000 kWh = 50000 x 0.02 = $ 1000

The remainder of the energy is = 260,000 – 153000 – 50000 = 57000 kWh

The energy charge for this remainder = 57000 x $0.012 = $ 684 Total
bill for the month = $ 12394

The average cost of energy = $12394/260000 = 4.77 cents/kWh

2. A small business can elect to use either the time-of-use (TOU) rate schedule shown below (column A) or the rate structure involving a demand charge (column B). During the peak demand period they use 100 kW of power and 24,000 kWh/month, while off-peak they use 20 kW and 10,000 kWh/month. Which rate schedule would give the lowest bills?

A. TOU Rate Schedule		B. Demand Charge Schedule	
On-peak	12¢/kWh	Energy charge	6¢/kWh
Off-peak	7¢/kWh	Demand charge	$9/mo-kW

Solution:

For rate schedule A, total bill in a month = 0.12 x 24000 + 0.07 x 10000 = $ 3580

For rate schedule B, total bill = 0.06 x (24000 + 10000) + $ 9 x 100 = $ 2940

Rate schedule B will result in lower bills.

3. Two consumers A and B each use 100,000 kWh/month. Customer A has a load factor of 15% and customer B has a 60% load factor (load factor, defined as the ratio of a customer's average power demand to its peak demand, is a useful way for utilities to characterize the cost of providing power to the customers). Using a rate structure with energy charges of $0.06/kWh and demand charges of $10/kW-month, compare their monthly utility bills.

Solution. They both have the same energy costs: 100,000 kWh/mo × $0.06/kWh = $6000/mo

Using (5.1), the peak demand for A is

$$\text{Peak(A)} = \frac{100{,}000 \text{ kWh/mo}}{15\% \times 24 \text{ h/day} \times 30 \text{ day/mo}} \times 100\% = 925.9 \text{ kW}$$

which, at $10/kW-mo, will incur demand charges of $9259/mo.

The peak demand for B is

$$\text{Peak(B)} = \frac{100{,}000 \text{ kWh/mo}}{60\% \times 24 \text{ h/day} \times 30 \text{ day/mo}} \times 100\%$$

$$= 231.5 \text{ kW} \qquad \text{costing } \$2315/\text{mo}$$

The total monthly bill for A with the poor load factor is nearly twice as high as for B ($15,259 for A and $8315 for B).