IQRA National University, Peshawar
Department of Electrical Engineering
Spring20
Power Generation
Assignment 1

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Question No 1 *(CLO -1)* ***20***

A. A 100kVA distribution transformer costs Rs 2,00,000 and has an estimated useful life of 20 years. Find the annual depreciation amount, assuming that the scrap value of the transformer to be Rs 10,000.
B. The average demand of a consumer is 40 A at 230 volts at unity power factor His total energy consumption annually is 10,000 KWh. If the unit rate is Rs 2 per kWh for the first 500hours use of the demand per annum plus Re 1 for each additional units, Calculate the annual bill of the consumer and equivalent flat rate.

Question No 2 *(CLO-2)* ***10***

A: power station has to supply load as follows:

Timings	**KW**
11 pm to 5 am	500
5 am to 6 am	750
6 am to 7 am	1000
7 am to 9 am	2000
9 am to 12 noon	2500
12 Noon to 1 pm	1500
1 pm to 5 pm	2500

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Q 1 (a):

Given that:

$$P = 200{,}000$$

$$S = 10{,}000$$

$$N = 20 \text{ years}$$

Depreciation $D = ?$

$$D = (P - S)/n$$

$$D = \frac{200{,}000 - 10{,}000}{20}$$

$D = Rs\,9500$ annually.

Q1 (b): Given:

Energy: $E = 10{,}000$ kWh

Current: $I = 40A$

Voltage: $V = 230V$

The Power demand of consumer

is $P = V_1 \cos Q = 230 \times 40 \times 1$

$= 9200\,W$ or $9.2\,KW$

Electricity consumption for the first

500 hours is $= 500 \times 9.2$

$= 4600\,kWh$

Since the cost of electricity is Rs2 per kWh of for the consumer has to pay;

$5400 \times 1 =$ Rs 5400

Annual bill $= 9200 + 5400$

$= 14,600$

The flate rate equivalent is :

$14600 / 10,000$

$=$ Rs 1.46 per kWh.

Q 2:

Solution:

Energy generated during 24 hours.

$= (500 \times 5) + (750 \times 1) + (1000 \times 1)$
$+ (2000 \times 2) + (2500 \times 3) + (1500 \times 1)$
$+ (2500 \times 4) + (2000 \times 2) + (2500 \times 2)$
$+ (1000 \times 2) + (500 \times 1)$

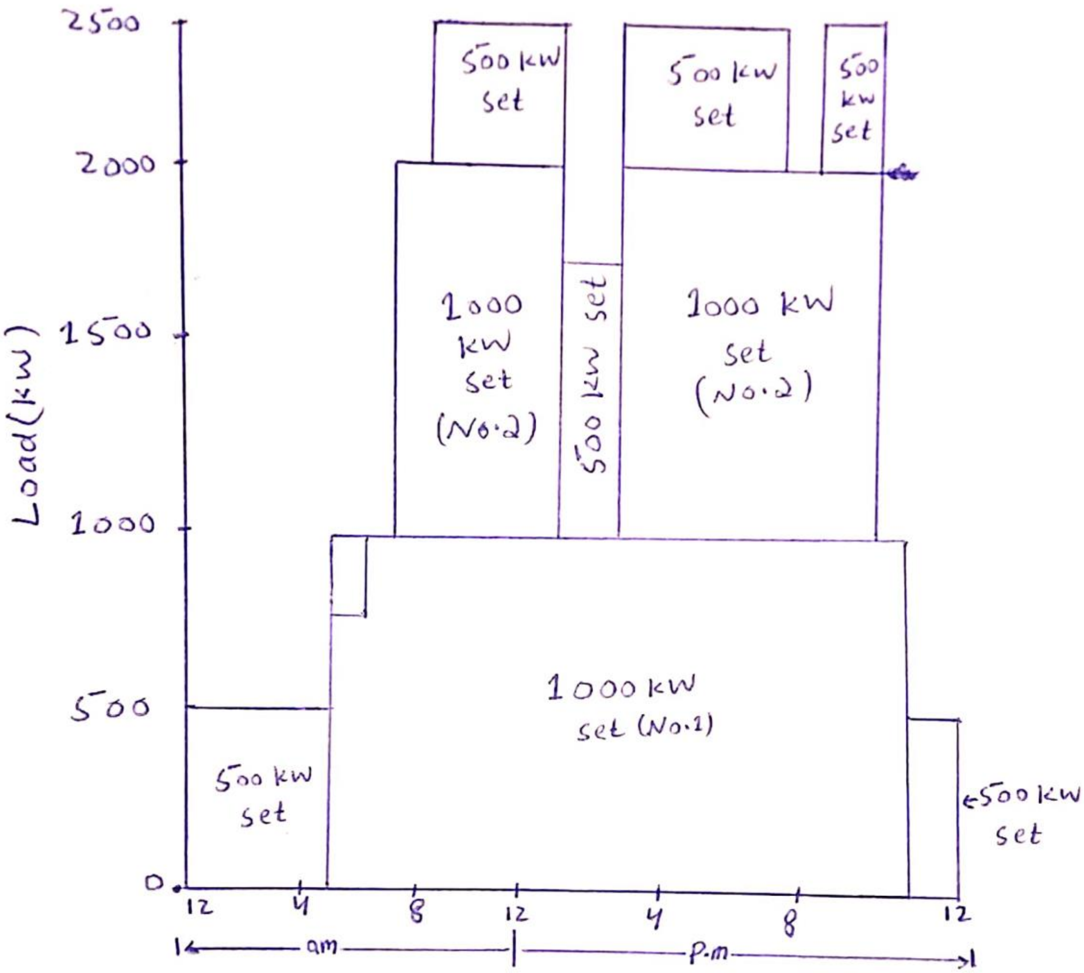
$= 38,750$ kWh

Maximum demand = 2500 kW

$$\text{Load factor} = \frac{\text{Energy generated during 24 hours}}{\text{Maximum demand} \times \text{24 hours}}$$

$$= \frac{38,750}{2500 \times 24}$$

$= 64.7\%$



Load curve of a power station.

Two sets each of 1000 kW capacity

One set of 500 kW capacity

The reserve capacity required will correspond to the largest size of the unit in the Station.

In this case a set of 1000 kW will have to be bought and kept as reserve - The total installed capacity of the station will

$1000 + 1000 + 500 + 1000$ (reserve) i.e. 3500 kW

$$\text{Plant capacity factor} = \frac{\text{Energy produced during 24 hours (kWh)}}{\text{Installed capacity (kW)} \times \text{24 hours}}$$

$$= \frac{38,750}{3500 \times 2} = 0.46 \text{ or } 46\%$$

$= 46\%$

The capacity of the individal sets is chosen as for as possible to fit approximately the load curve. Next it should be decided how, when and in what sequence the sets should be started and run.

From 11pm to 5 a.m. only 500kW set is run.

At 5am the load is expected to increase The first 1000 kW set is started and paralled with the 500kW set, all the load is transferred to the 1000kW set, and then 500kW set is stopped.

Thus one set of 1000kW is run from 5a.m to 7 a.m. taking up the necessary Load.

Just before 7a.m. when an increase in load is expected, the second 1000kW set is started and paralled with the first one.

From 7am. to 9a.m. both the 1000 kW sets are running together.

At 9a.m. still more load is expected, the 500kW set is started and paralled with the other sets on the busbars and loaded along with them. Thus at the time of supplying the maximum load b/w 9a.m. and 12 noon, all the three sets are running on full Load. One of the 1000kW sets is stopped after the load has dropped to 1500 kW.

From 1p.m to 5pm. this set is run again along with the two other.

At 5pm the load again drops, owing to the working shift shift in industries being over. The Load on the 500kW set is removed and then this set is taken out of commision.

At 7pm the load increase owing to lighting and all the three sets are run until 9pm.

At 9pm two set are taken out and only one 1000kW is run untill 11pm.

After 11pm only the 500kW set need be run.

At each time of change-over, care should be taken to ensure correct Paralleling and load transfer.

With the operating schedule fixed as above the energy that could have been generated by the capacity of Plant running for the sheduled time would be

(500x6) + (1000x2) + (2000x2) + (2500*3)
+ (1500x1) + (2500x4) + (2000x2) + (2500x2)
+ (1000x2) = 39,000 kWh

Energy actually produced = 38,750 kWh

Plant use factor = $\frac{\text{Energy Produced (kWh)}}{\text{capacity of Plant (kW)} \times \text{Number of hours}}$

Plant has been in operation

$= \frac{38,750}{39,000} = 0.994$ or 99.4%

$= 99.4\%$