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. 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
5 pm to 7 pm	2000
7 pm to 9 pm	2500
9 pm to 11 pm	1000

For the given data above draw the load curve. Select the number and size of generator units to supply this load. Find the reserve capacity of the plant required. Calculate the plant capacity factor. Determine the operating schedule of the units in the station. Calculate the plant factor?

Q 1(A): A 100 KVA distribution transformer cost Rs 2,00,000 and has an estimated usefull life of 20 years. Find the annual depreciation amount, assuming the scrap value of transformer to be Rs 10,000

Ans:

Given Data:

$P = 2,00,000$

$S = 10,000$

$N = 20$ years

Required:

Depreciation $D = ?$

Formula:

$$D = \frac{(P-S)}{n}$$

Solution:

$$D = \frac{(P-S)}{n}$$

$$D = \frac{200,000 - 10,000}{20} = \frac{190,000}{20}$$

$D = 9500$ annually

Q No1 (B):

The average demand of a Consumer is 40 A at 230V 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 500 hours use of the demand Per Annum plus Rs 1 of each additional unit. Calculate the annual bill of the Consumer and equivalent flat rate.

Ans:

Given Data:

Energy = E = 10000 KWh

Current = I = 40 A

Voltage = V = 230

Required:

Annual bill = ?

Equivalent Flat Rate = ?

Solution:

$P = VI\cos\phi$

$P = 230 \times 40 \times 1$

$P = 9200\,W$

$P = 9.2\,KW$

First 500 hour Electricity consumption = 500×9.2 = 4600 KWh

Cost when electricity Rs 2 Per KWh of the first 500 hours, Consumer has Pay

4600 X 2

Rs = 9200

Remaning unit = 10000 - 4600
5400

When electricity cost Rs 1 Remaining
5400 X 1
= 5400

Annual bill = 9200 + 5400
= 14600

Flat Rate equivalent is = $\frac{14600}{10000}$

Rs = 1.46 Per Kwh

Q2: A Power Station has to supply load as follows.

Timings	KW
11 Pm to 5am	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 PPm	1500
1 Pm to 5 Pm	2500
5 Pm to 7 Pm	2000
7 Pm to 9 Pm	2500
9 Pm to 11 Pm	1000

For the give data above draw the load curve. Select the number and size of generator unit to supply this load Find the reserve capacity of the plant required Calculate the plant capacity factor. Determine the operating sechdule of the unit in the station. Calculate the plant factor.

Ans: Figure is a load curve plotted from the above data. The maximum demand is 2500 KW If water resources were not availeble in the vicinity The Plant would be Diesel electric

For a Privately owned Plant it Could be Steam Station If a local Condition were Suitable. The method and Considerations for the Section of Size of Generating Unit are however, common to all type of Station so far as fitting in the load curve is Connected.

Energy generated during 24 hours =
(500X5) + (750 X 1) + (1000X1) + (2000X2) + (2500X3) + (1500X1) + (2500X4) + (2000X2) + (2500X2) + (1000X2) + (500X1)
= 38750 KWh

Maximum demand = 2500 KW

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

$$\text{Load factor} = \frac{38750}{2500 \times 24}$$

$$= 64.7\ \%$$

From the nature of load curve. it will be Seen that this is the load of a Small industrial town will distributed during day and night From the load curve it will also be seen that three generator set will suffice with the following rating

Two set each of 1000 KW capacity

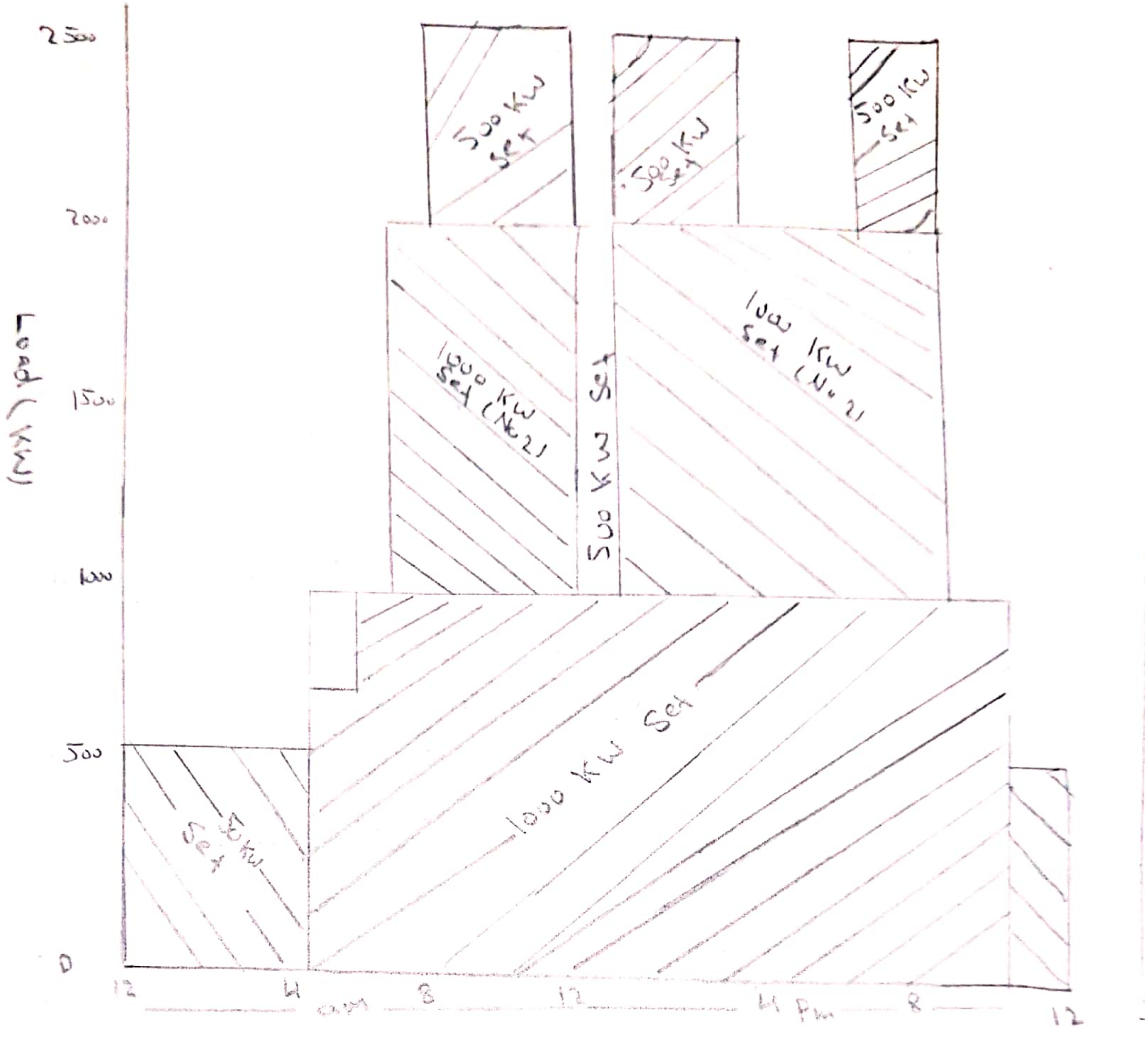
one set of 500 KW capacity

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 therefore be 1000 + 1000 + 500 + 1000 (reserve) i.e 3500 KW

$$\text{Plant Capacity factor} = \frac{\text{Energy Produced during 24 hours (kwh)}}{\text{installed Capacity (KW)} \times 24 \text{ hours}}$$

$$\text{Plant Capacity factor} = \frac{38{,}750}{3500 \times 24}$$

Plant Capacity factor = 0.46 or 46%.



Load Curve of a Power Station

The Capacity of the individual Set is Chosen as far as Possible to fit approximately the load curve Next it Should be decided how, When and in What Sequence the Set Should be Started and run. This arrangement is Known as the operating Sechdule of the Station In arranging this Sechdule care is taken to see that the Plant of the required capacity is kept ready for loading at the expected time to the load. The capacity of the Plant started and kept ready might be larger than necessary but should not be inadequate.

With the type of load curve show in figure and the sizes of the unit selected as above the operating sechdule can be arranged as follows.

From 11 P.m to 5 am only the 500 KW set is run

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

Thus one set of 1000 KW is run from 5 am to 7 am taking up the necessary load.

Just before 7 am when an increase in load is expectet, the second 1000 KW set is started and Parallel with the first one.

From 7 a.m to 9 a.m both the 1000 KW Sets are running together.
At 9 a.m Still more loaded is expected the 500 KW Set is Started and Parallel With the other Set on the busbar and loaded along With them. Thus at the time of Supplying the maximum load between 9 a.m and 12 noon all the three Sets are runing on full Load.
Between 12 noon and 1 P.m the load decreases, owing ~~the~~ to recess-lunch-time-in industrial Plant. one of the 1000 KW Sets is stopped after the load has dropped to 1500 KW
From 1 P.m to 5 P.m this Set is run again along With the two other. At 5 P.m the load again drops owing the working Shift in industries being over. The load on the 500 KW Set is removed and then this Set is taken out of Commision

From 5 P.m to 7 P.m only both the 1000 KW Set are running.
At 7 P.m the load increase, owing to lighting and all the three Set are run until 9 P.m
At 9 P.m two Sets are taken out and only one 1000 KW is run until 11 P.m.
After 11 P.m only the 500 KW Set need be run.
At each time of Change-over, care should be taken to ensure correct ~~ing~~ Parallelling and load transfer
With the operating Sechdule fixed as above the energy that could have been generated by the capacity of plant actually running for the Sechdule time would be
(500×6) + (1000×2) + (2000×2) + (2500×3) + (1500×1) +
(2500×4) + (2000×2) + (2500×2) + (1000×2).
= 39750 KWh

(ii)

$$\text{Plant use factor} = \frac{\text{Energy Produced (KWh)}}{\text{Capacity of Plant (KW)} \times \text{Number of hours Plant has been in operation}}$$

$$\text{Plant use factor} = \frac{38{,}750}{39000}$$

Plant use factor = 0.994 or 99.4 %