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

Name: ______________

REG.No:______________

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?

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Q1 :- (a)

Sol :- Given data

$P = 2,00,000$

$S = 10,000$

$N = 20$ years

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

$$D = \frac{2,00,000 - 10,000}{20}$$

$$D = \frac{190,000}{20}$$

$D = 9,500$ Annually.

Q1 :- (b)

Sol:-

Given data

$E = 10,000$ Kwh

$I = 40$ A

$V = 230$ volts

$P = VI \cos Q$

$= 230 \times 40 \times 1$

$= 9200$ W or 9.2 Kw

Electricity consumption for the first 500 hours

$= 500 \times 9.2 = 4600$ Kwh

The cost of electricity is Rs 2 per Kwh for the first 500 hrs, then the constumer has to pay

$4600 \times 2 = 9200$ Rs

For the remaining units

$10{,}000 - 4600 = 5{,}400$

Consumer has to pay

$5400 \times 1 = 5400$ Rs

Annual bill

$= 9200 + 5400$

$= 14{,}600$ Rs

Flate rate equivalent

$$= \frac{14600}{10{,}000}$$

$= 1.46$ per kwh

Q2 (A)

Sol:- In the figure load curve Plotted from the above data. The maximum demand is 2500 KW. If water resources were not available in the vicinity the plant would normally be diesel-electric. For a privately owned plant it could be a stream station if local condition were suitable. The methode and consideration for the selection of size of generating units are, however common to all types of stations so far as fitting in the load curve is concerned.

Energy generated during 24 hours

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

$= 38{\cdot}750$ Kwh

Maximum demand = 2500 Kw

Load factor = $\frac{\text{Energy generated during 24hrs}}{\text{Maximum demand} \times 24\text{hrs}} = \frac{38.750}{2500 \times 24}$

= 64.7 %

From the nature of load curve it will be seen that this is the load of a small industrial town well distributed during day and night. From the load curve it will also be seen that three generator sets will suffice with the following ratings :-

Two sets each of 1000 kw capacity

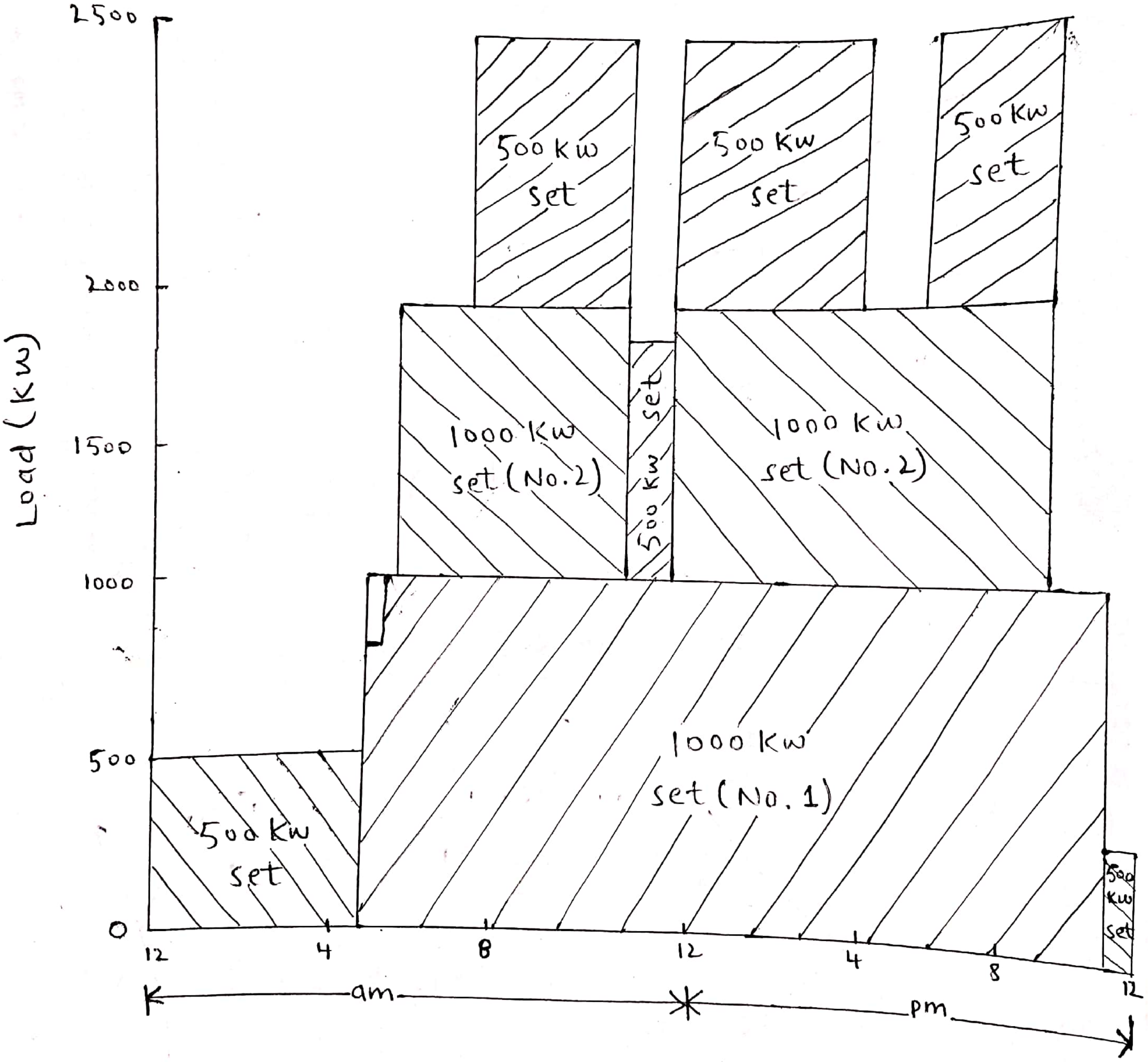
One set of 500 kw capacity

The reserve capacity required will correspond to the largest size of the unit of the station. In this case a set of 1000 kw will have to be bought and kept as reserve. The totall installed capacity of the station will be 1000 + 1000 + 500 + 1000 (reserve) i-e 3500 kw.

⑥

$$\text{plant capacity factor} = \frac{\text{Energy produced during 24hrs (Kwh)}}{\text{Installed capacity (Kwh)} \times 24\text{hrs}}$$

$$= \frac{38{,}750}{3500 \times 24} = 0.46 \text{ or } 46\%$$



Load curve of power station

The capacity of the individual sets is chosen as far as possible to fit approximatly the load curve.

With the type of load curve shown in figure and the sizes of units selected as the operating schedule can be arranged as follows:

From 11 p.m to 5 a.m only the 500 kw set is run.

At 5 a.m the load is expected to increase. The first 1000 kw set is, Therefore started and paralled with 500 kw set all the load transfered to the 1000kw set and then the 500kw set is stopped.

Thus one set of 1000kw is run from 5 a.m to 7a.m taking up the necessary load. Just before 7a.m. When an increase in load is expected, the second 1000 kw set is started and paralleled with the first one. From 7 a.m to 9 a.m both the 1000 kw sets are runing together.

At 9 a.m still more load is expected, the 500 Kw set is started and paralleled with the other sets on the busbars 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 running on full load.

Between 12 noon and 1 p.m the load decreases, owning to recess - lunch time - in industrial plants. One of the 1000 Kw set is ~~dropped~~ 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 others.

At 5 p.m the load again drops, owning to the working shift in industries being over. The load on the 500 Kw set is removed and then this set is taken out of commission. From 5 p.m to 7 p.m only both the 1000Kw sets are running.

At 7 p.m the load increases, owning to lighting and all the three sets are run until 9 p.m. At 9 p.m two sets are taken out and only one 1000Kw is run until 11 p.m. After 11 p.m only 500Kw set need to 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 the energy that could have been generated by the capacity of plant actually running for the scheduled time would be

$(500 \times 6) + (1000 \times 2) + (2000 \times 2) + (2500 \times 3) + (1500 \times 1) +$
$(2500 \times 4) + (2000 \times 2) + (2500 \times 2) + (1000 \times 2) = 39000$ kwh

Energy actually produced $= 38750$ kwh

plant use factor $= \dfrac{\text{Energy produced (kwh)}}{\text{Capacity of plant (kw)} \times \text{No. of hours plant has been in operation}}$

$= \dfrac{38750}{39000} = 0.994$ or 99.4%

x ———————— x