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?

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Subject: Power Generation

Question # 1 (a):

A 100KVA distribution transformer costs Rs 200000 and has an estimated useful life of 20 years. Find the annual depresciation amount, assuming that the scrap value of of the transformer to be Rs 10,000.

Given data:

$P = 200000$

$S = 10{,}000$

$N = 20$ years

Solution:

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

putting the values:

$$D = \frac{(200{,}000 - 10000)}{20}$$

$D =$ RS 9500 Annully

Question # 1 (b):

The avarage Demand of the consumer is 40 A at 230 volts at unity power factor His total energy consumption annually is 10000 Kwh if the unit rate is Rs 2 per Kwh for the first 500 hours use of the demand per annum plus Re 1 for each additional units calculate the annual bill of the consumer and equivalent flat rate.

Given Data:

Energy (E) = 10,000 KWh

Current (I) = 40 A

Voltage (V) = 230 V

Solution:

The power Demand of the consumer is :

$$P = VI\cos\phi$$

$$= 230 \times 40 \times 1$$

$$= \boxed{9200\,W \text{ or } 9.2\,KW}$$

Electricity consumption for the first 500 hours is :

$= 500 \times 9.2$

$= \boxed{4600 \text{ Kwh}}$

Since the cost of electricity is RS 2 per Kwh of for the first 500 hours therfore the consumer has to pay:

$5400 \times 1 = RS\ 5400.$

Annual bill $= 9200 + 5400$

$= \boxed{14600}$

The flate rate equalantly:

$14600 / 10000 = \boxed{1.46 \text{ per Kwh}}$

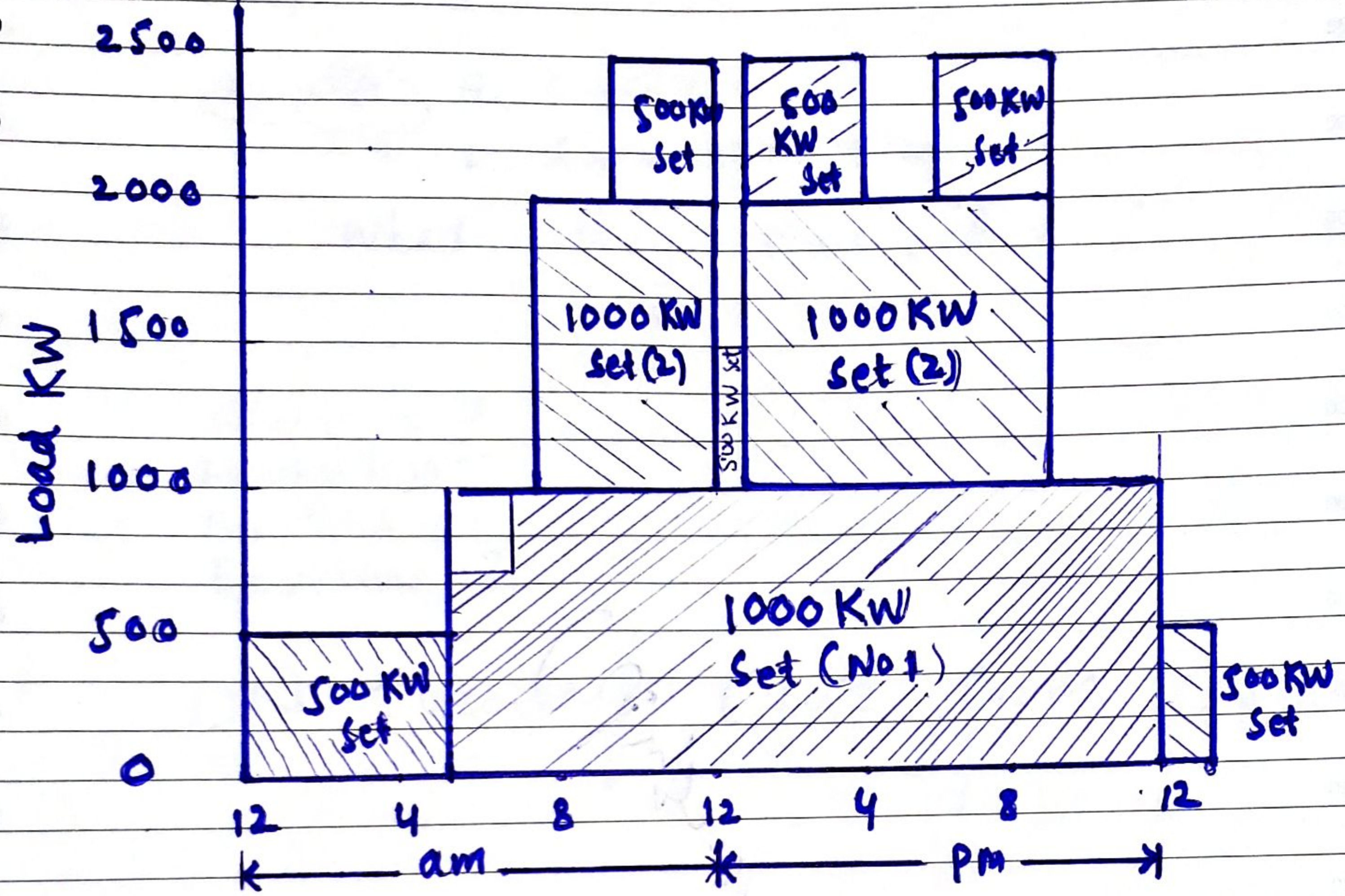
Question # 2 (a)

A power station has to supply load as follow:

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 reserse capacity of the plant required. calculate the plant capacity factor. Determine the operating schedule of the units in the station. calculate the plant factor?

Load curve:



Load curve of power station.

Select the number and size of generator units:

From the load curve its seen that three generator sets will suffice with the following ratings:

Two sets each of 1000 KW capacity

one set of 500 KW capacity.

In figure a load curve plotted from the above Data. The maximum demmand is 2500 KW. if water resources were not available in the vicinity. The plant would normally be diesel-electric. The method and considrations for the selection of size of generating units are however, common to all types of stations so far as fitting in the load curver is concerned.

Energy generated during 24 hours:

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

$$= \boxed{38,750 \text{ KWh}}$$

Maximum Demand = **2500 KW**

$$\text{Load factor} = \frac{\text{Energy generated during 24 hours}}{\text{Maximum Demand} \times 24 \text{ hours}} = \frac{38750}{2500 \times 24}$$

$$= 64.7\%$$

The reserve capacity of the plant required :

The resere 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 resere.

Plant capacity factor:

The totall installed capacity of the station will therefore be 1000 + 1000 + 500 + 1000 (reserve). i.e 3500 KW

plant capacity factor =

$$\frac{\text{Energy produced during 24 hours (KWh)}}{\text{installed capacity (KW)} \times 24 \text{ hours}}$$

$$\frac{38{,}750}{3500 \times 24}$$

$$= 0.46 \text{ or } 46\%$$

Operating Shedule:

The operading shedule can be arranged as follows:

(1) From 11pm to 5pm only the 500 KW set is run.
At 5am the load is expected to increase the first 1000KW set is therefore started and parralleld with the 500 KW set all the load is transferred to the 1000KW set and then the 500 KW set is stopped'
Thus one set of 1000KW is run from 5 am to 7 am. taking up the necessary load Just before 7 am. when an increase in load is expected the second 1000 KW setarted and parralled with the first one.

(2) From 7 am to 9 am both the 1000 KW sets are running together.

(3) At 9am still more load is expected the 500KW set is started and paralleld with the other sets on the busbars and loaded along with them. Thus at the time of supplying the maximum load between 9am and 12 noon. all the sets are running on full load.

(4) Between 12 noon and 1pm the load decreases, owing to recess-lunch time. in industrial plants one of the 1000KW sets is stopped after the load has dropped to 1500KW.

(5) At 5pm the load again drops. owning to the working shift in industries being over. the load on the 500KW set is removed and then this set is taken out of commision.

(6) From 5pm to 7pm only both the 1000KW are running.

(7) At 7pm the load increases owing to lighting and all the three sets are run untill 9pm.

(8) At 9pm two sets are taken out and only one 1000 KW is run untill 11 pm

(9) After 11 pm only the 500 KW set need be run.

(10) At each time of change over care should be taken to ensure correct paralleling and load transfer.

Plant factor:

with the operating shedule fixed as above the energy that could have been generated by the capacity of plant actually running for the scheduled time would be.

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

$+ (2000 \times 2) + (2500 \times 2) + (1000 \times 2) = \boxed{39000 \text{ KWh}}$

Energy actually produced $= \boxed{38750 \text{ KWh}}$

$$\text{plant use factor} = \frac{\text{Energy produced (KWh)}}{\text{capacity of plant (KW)} \times \text{number of hours}}$$

$$= \frac{38750}{39000}$$

$$= 0.994 \text{ or } 99.4\ \%$$