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?

★ MID TERM ★

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★ SEMESTER:- 6th

★ PAPER:- POWER GENERATION

Q1:- (Part-A) A 100KVA distribution transformer costs Rs 200,000 & has an estimated useful life of 20years. Find the annual depreciation amount, assuming that the scrap value of the transformer to be Rs.10,000.

★ Given data:-

Cost = P = 200,000

Scrap value of transformer = S = 10,000

Useful life of asset = n = 20 years

★ Required data:-

Find the annual depreciation amount = D = ?

★ Solution:-

As we know from straight line Depreciation Expense

$$\text{Depreciation Expense} = \frac{\text{Cost} - \text{Salvage Value}}{\text{Useful life of the asset}}$$

$$D = \frac{P-S}{ns} \longrightarrow (1)$$

put values in eq (1)

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

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

$$D = 9500 Rs$$

★ **Result:-**

So, the annual depreciation amount will be = 9500Rs anually.

Q1:- (Part - B) The average demand of a consumer is 40A at 230volts at unity power factor. His total energy consumption anually is 10,000KWh. If the unit rate is Rs.2 per KWh for the first 500hours use of the demand per annum plus Rs 1 for each additional units, Calculate the annual bill of the consumer & equivalent flat rate.

★ **Given data:-**

Energy Consumed = E = 10,000 kwh
demand of Consumer Current = I = 40A
at Voltage = V = 230 volts

★ **Required:-**

Annual bill of Consumer = ?
Equivalent flat rate = ?

★ **Solution:-**

First we find Power = P
where $P = VI\cos\theta$
So, the Power demand = $P = 230 \times 40(1)$
∵ V & I perpendicular to eachother $\cos 90° = 1$

then, $P = 9200W$
So, $P = 9.2kW$

No we find the electricity consumtion for first 500 hours which will be
⇒ $500 \times 9.2 = 4600 kwh$

As the cost is Rs.2 per unit of first 500hours.
therefore the consumer will pay
⇒ $4600 \times 2 = 9200 Rs$
And now for remaining units which is $10,000 - 4600 = 5,400$

So, for remaining 5,400 units he will pay ⇒ 5400 × 1 = 5400 Rs

: 1 Rs per unit will charge

therefore the annual bill will be

⇒ 9200 + 5400 = 14600 Rs

& the flat rate equivalent will be

⇒ 14600/10,050

= 1.46 per kWh

★ **Result:-**

So, the Annual bill of consumer will be = 14,600 Rs

& the Equivalent flat rate = 1.46 per/kWh

Q2:-

★ **Solution:-**

The maximum demand is 25000 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 steam station if local conditions were suitable. The method & considerations 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 connected.

Energy generated during 24-hours

$$= (500\times5) + (750\times1) + (1000\times1) + (2000\times2) + (2500\times3) + (1500\times1) + (2500\times4) + (2000\times2) + (2500\times2) + (1000\times2) + (500\times1)$$

$$= 38,750 \text{ kWh}$$

Maximum demand = 2500 kW

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

$$= \frac{38,750}{2500\times24}$$

Load factor = 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 & night. From the load curve it will also be seen that three generator sets will suffice with the following ratings.

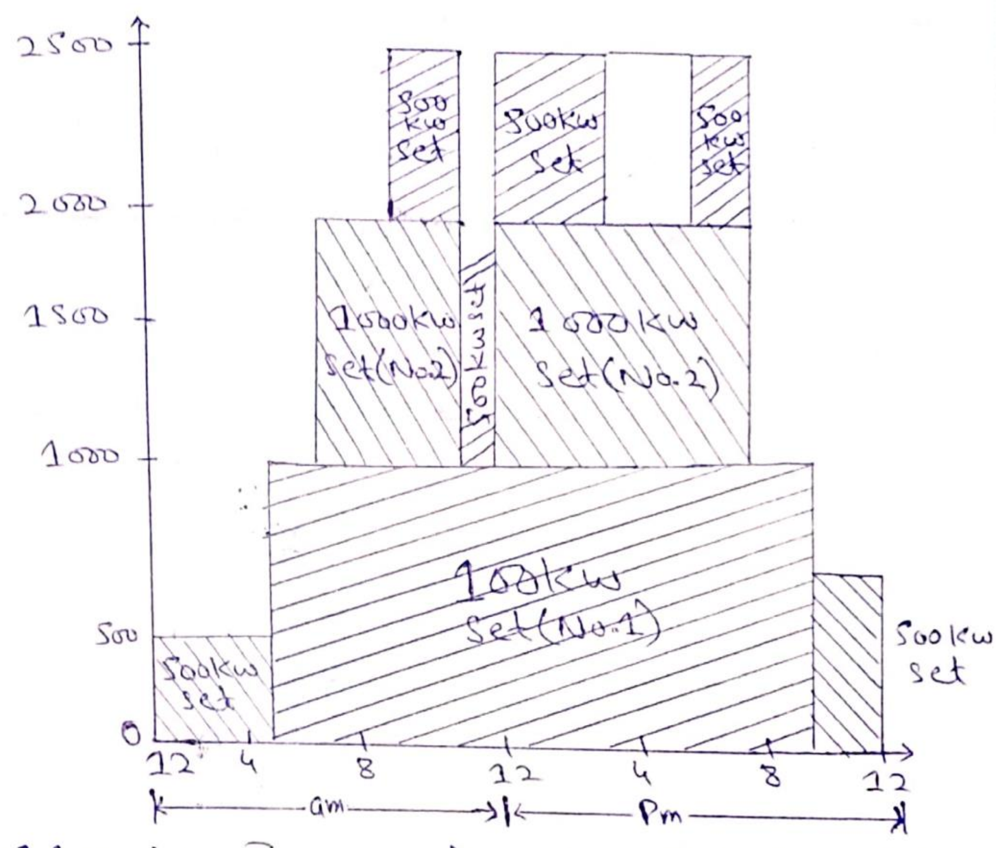
Two sets each of 1000 kW capacity

One sets of 500 kW capacity

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

Plant Capacity Factor = $\frac{\text{Energy Produced in 24hrs}}{\text{Installed Capacity} \times 24\text{hours}}$

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



From 11pm to 5am only the 500kw set is run. At 5am the load is expected to increase. The first 1000kw set is, therefore, started & paralleled with the 500kw set.

all the load' is trasferred to the 1000kw set & then the 500kw set is stopped. Thus set of 1000kw is run from 5am to 7am taking up the necessary load. Just before 7am when an increase in load is expected, the second 1000kw set is started & paralleled with first one From 7am to 9am both the 1000kw sets are running together.

Thus at time of supplying the maximum load between 9am & 12noon, all the three sets are running on full load.

Between 12noon & 1pm the load decreases One of the 1000kw sets is stopped after the load has dropped to 1500kw.

From 1pm to 5pm this set is run again along with two others.

At 5pm the load again drops, owning to lighting & all the three sets are run until 9pm.

After 11pm only 500kw set need to be run At each time of change-over, care should be taken to ensure correct paralleling & 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

$= (500 \times 6) + (1000 \times 2) + (2000 \times 2) + (2500 \times 3) + (1500 \times 1) + (2500 \times 4) + (2000 \times 2) + (2500 \times 2) + (1000 \times 2) = 39,000 kWh$

Energy actually produced $= 38,750 kWh$

$$\text{Plant use factor} = \frac{\text{Energy Produced (kWh)}}{\text{Capacity of plant} \times \text{No. of hours plant has been in operation}}$$

$$= \frac{38,750}{39,000}$$

$$= 0.994 \Rightarrow 99.4\%$$

★ **Result:-**

So, Load factor = 64.7 %
Plant capacity factor = 46%
Plant use factor = 99.4%