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

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

A. What is meant by electricity tariff, explain different classes of tariff with examples?
B. Define Load Factor, Diversity Factor, Plant Capacity Factor and Plant Use Factor?

***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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## Q#1 what is meant by electricity tariff, explain different classes of tariff with examples?

**Ans:** The amount of money frame by the supplier for the supply of electrical energy to various types of consumers in known as an electricity tariff.

The rates depend upon the total energy consumed and the load factor of consumer. In power system tariff is charged in a form of bill on monthly basis.

The actual tariffs that the customer pay depends on the consumption of the electricity. The consumer bill varies according to their requirements. The industrial consumers pay more tariffs because they use more power for long times than the domestic consumers. The electricity tariffs depend on the following factors

- Type of load
- Time at which load is required.
- The power factor of the load.
- The amount of energy use

### TYPES OF ELECTRICITY TARIFF

PLAIN TARIFF

TWO PART TARIFF

THREE PART TARIFF

### PLAIN TARIFF

In a plain tariff it is the cost of electricity units in term of KWh(1 unit=1kwh)actually used by consumers are charged in the bill and therefor only consist of variable component.

The units in term of Kwh are registered by the energy meter installed at consumer premises.

**TWO-PART TARIFF** – In such type of tariff, the total bill is divided into two parts. The first one is the fixed charge and the second is the running charge. The fixed charge is because of the maximum demand and the second charge depends on the energy consumption by the load.

$$C = Ax + By$$

$$C = A(kW) + B(kWh)$$

The factor A and B may be constant and vary according to some sliding.

### Example

credit cards which charge an annual fee plus a per-transaction fee

landline telephones where there is a fee to use the service ('line rental') and also a fee per call. The line rental covers the cost of providing the service, the per minute charge covers the cost of placing the call on the network

**THREE PART TARIFF**: when the total charge to be made from the consumer is split into three part, fixed charge, semi fixed charge and running charge, it is known as three-part tariff.

Total charge= RS(a+bxKw+cxKwh)

a=charge made during each billing period.

It includes interest and depreciation on the cost of secondary distribution and labor cost of collecting revenues.

**Fixed charge** recovers the cost on account of expenses in giving a supply (of any sort or of any magnitude) service connection (incurred once only but charged for either by a capital or an annum sum or charged each billing period), office and service expenses including accounting, metering and establishment charges

**Semi-fixed charges**, which are levied on the basis of maximum demand in kW or kVA,

. recovers the plant initial cost as well as that operating cost which is independent of . . .

. total energy supplied by it and varies with the variation in maximum demand.

**Variable charges**, which are levied on the basis of energy consumed, recovers the cost varying with the variation in energy supplied such as on account of fuels etc.

## Q.1(B) Define load Factor, diversity factor, Plant factor, Plant Capacity factor and plant use factor?

Ans

**LOAD FACTOR**: Load factor is defined as the ratio of the average load over a given period to the maximum demand (peak load) occurring in that period. In other words, the load factor is the ratio of energy consumed in a given period of the times of hours to the peak load which has occurred during that particular period.

$$Load\ factor = \frac{average\ load}{peak\ load}$$

Load factor means how efficiently we use energy. It is the measure of the utilisation of electrical energy during a given period to the maximum energy which would have been utilised in that period. The load factor plays an important role in the cost of generation per unit (kWh). The higher the load factor the smaller will be the generation cost for the same maximum demands.

**DIVERSITY FACTOR**: The diversity factor is the ratio of the sum of the individual maximum demands of the various subdivisions of a system to the maximum demand of the whole system.'

The maximum demands of the individual consumers of a group do not occur simultaneously. Thus, there is a diversity in the occurrence of the load. Due to this diverse nature of the load, full load power supply to all the consumers at the same time is not required.

$$Diversity\ factor = \frac{(sum\ of\ individual\ maximum\ demands)}{(coincident\ maximum\ demand\ of\ the\ whole\ system)}$$

**PLANT CAPACITY FACTOR**: The capacity factor is defined as the ratio of the total actual energy produced or supply over a definite period, to the energy that would have been produced if the plant (generating unit) had operated continuously at the maximum rating.

The ratio of actual energy produced in kilowatt hours (kWh) to maximum possible energy produced that could have been produced during the same period

$$\text{. Plant capacity factor} = \frac{\text{Average load x 24}}{\text{Plant capacity x 24}} = \frac{\text{Average load}}{\text{Plant capacity}}$$

**PLANT USE FACTOR**

It is the ratio of kWh generated to the product of the **plant** capacity and the number of hours for which the **plant** was in operation.

It show the extent to which the plant capacity is used to meet the peak demand.

$$\text{PLANT USE FACTOR} = \frac{\text{Annual energy produced}}{\text{capacity of plant x No.of hours plant is in operation during year}}$$

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

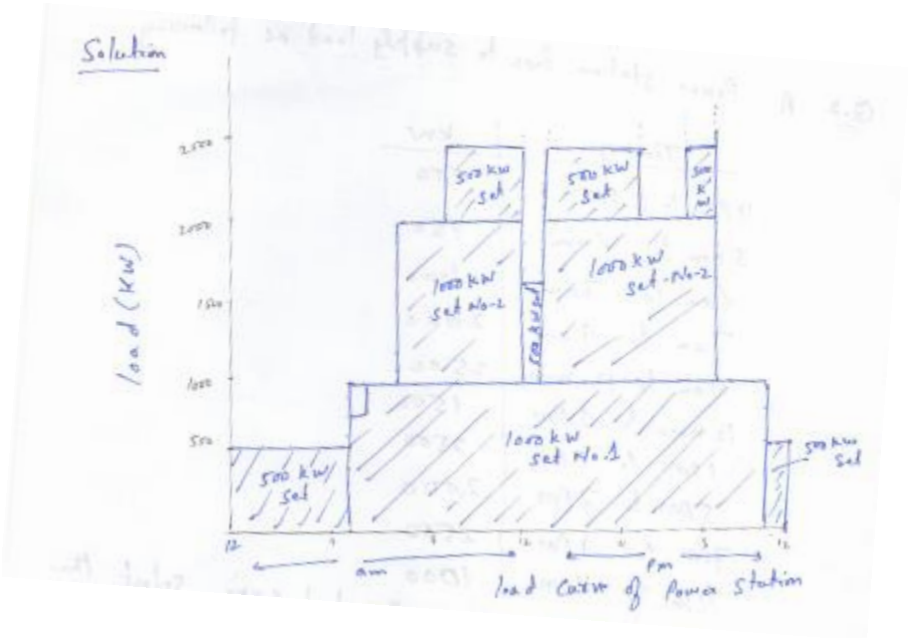
A. A power station has to supply load as follows:

| 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?

## ANS

### LOAD CURVE OF POWER STATION



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### NUMBER AND SIZE OF GENERATOR UNITE TO SUPPLY

From the nature of load curve. it will be seen that this is load of small industrial town.

Will distributed during day and night that three generator sets will suface with the following rating

**Two sets each 1000 kw capacity**

**One set 500 kw capacity**

## RESERVE CAPACITY

The reserve capacity required will correspond to the largest size of unite in the station.

In this case a set of 1000 kw will have to be bought and kept as reserve. The total install capacity of station will =1000kw +1000kw+500kw+1000kw

=3500 kw

### PLANT CAPACITY FACTOR

Energy generated during 24 hours

= (500x5)+750(1)+1000(1)+2000(2)+2500(3)+1500(1)+2500(4)+2000(2)+2500(2)

+1000(2)+500(1)

=38.750kwh

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

Plant capacity factor =38.750/3500x24

=0.46 or 46%

## OPERATING SCHEDULE OF THE UNITE IN THE STATION

Operating schedule can be arranged from load curve.

**11 am to 5 am**: only 500 kw set is run

**5am to 6am**: the load is increase ,500 kw set is stop, 100kw set is run

**6am to 7am**: only 1000 kw set is run

**7am to 9am**: the load is increased. the second 1000kw set is run parallel with first one set(1000kw)

**9 am to 12 noon**: the load is increase. 500kw set is started parallel with two other(1000kw)

All three sets are running (1000kw+1000kw+500kw)

**12 noon to 1 pm**: the load is decreasing (lunch timing)

One of 1000kw set is stopped.

**1pm to 5pm**: all three set are running (1000kw +500kw+1000kw)

**5pm to 7pm**: the load is decreasing. Both the 1000kw set are running, and 500 kw set is stopped.

**7pm to 9 pm**: the load is increasing; all three sets are running.

**9pm to 11 pm**: the load is decreasing, two sets have removed (1000kw and 500kw) and one set 1000kw is run

**11pm to 5pm**: the load is decrease, only 500kw set is run, and remaining two set is off.

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## PLANT FACTOR:

The energy that could have been generated by capacity of plant actually running for the scheduled time would be

=500(5) +1000(2)+ 2000(2)+2500(3)+1500(1)+2500(4)+2000(2)+2500(2)

+1000(2) +500(1)

=39,000 kwh

**Plant use factor = energy produc (kwh)/capacity of plant(kw) x No of hours plant has operation**

Plant use factor = 38,750/3900

=0.994 or 99.4 %

End