بسم الله الرحمن الرحيم

Benha University

Prof . Mohamed Ahmed Ebrahim

Benha University
Faculty of Engineering at Shoubra
Electrical Engineering Dept.

Energy Storage & Transmission

By

Associate Prof. / Mohamed Ahmed Ebrahim Mohamed

E-mail: mohamedahmed_en@yahoo.com

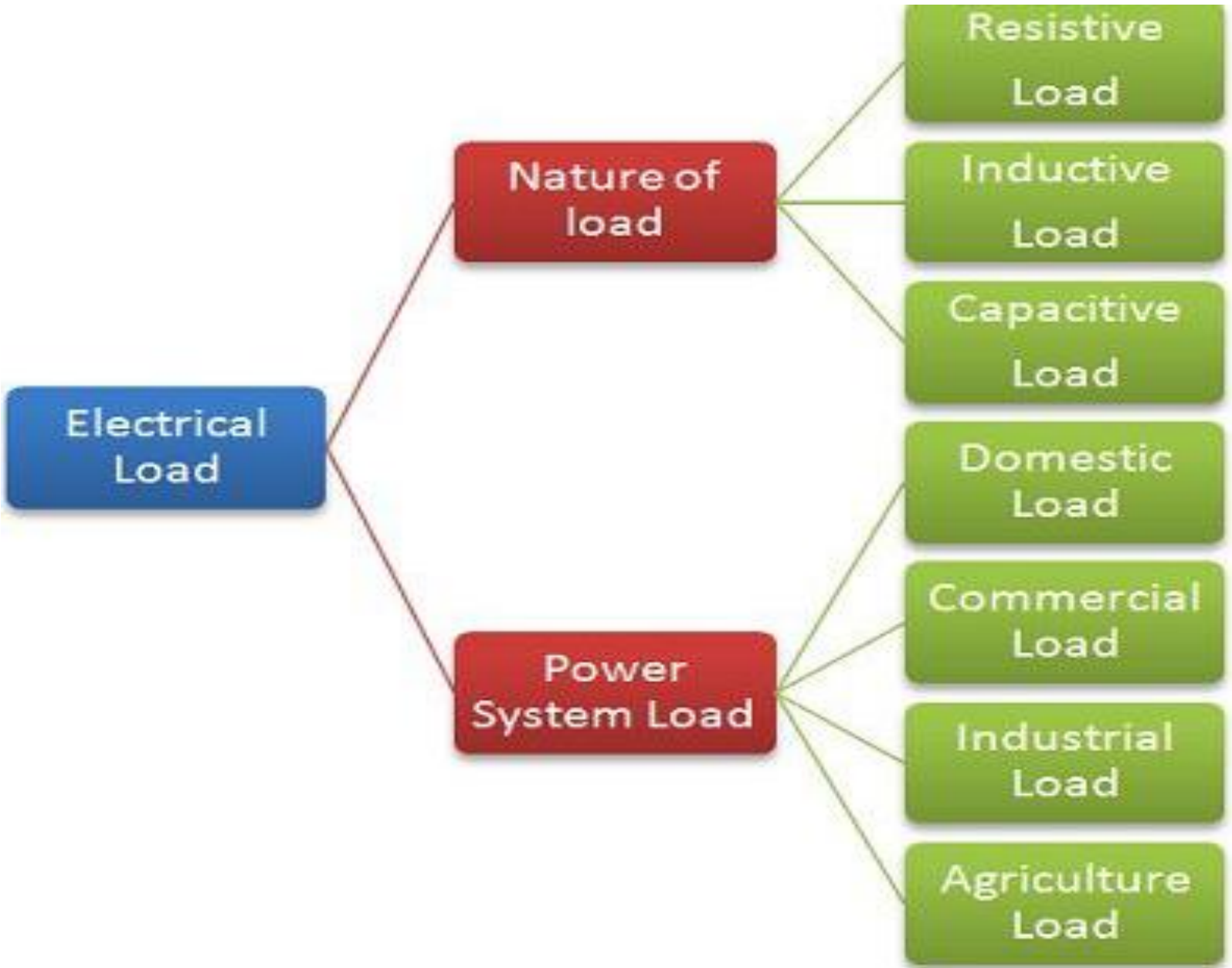mohamed.mohamed@feng.bu.edu.eg

Web site: http://bu.edu.eg/staff/mohamedmohamed033

Lecture (6)
01– 04 - 2019

Differences between Electrical Loads
&
Power Systems Loads

Prof . Mohamed Ahmed Ebrahim

Types of Electrical Loads

- An **<u>electrical load</u>** is a device or an electrical component that consumes electrical energy and convert it into another form of energy.

- **<u>Examples of electrical loads</u>** Electric lamps, air conditioners, motors, resistors etc.

- They can be classified according to their nature as **Resistive, Capacitive, Inductive, and combinations of these.**

Prof. Mohamed Ahmed Ebrahim

1. Resistive Loads

□ Two common examples of resistive loads are **incandescent lamps** and **electric heaters**.

□ Resistive loads consume electrical power in such a manner that the current wave remains in phase with the voltage wave. That means, **power factor** for a resistive load is unity.

Prof. Mohamed Ahmed Ebrahim

2. Capacitive Loads

☐ A capacitive load causes the current wave to lead the voltage wave. Thus, power factor of a capacitive load is leading.

☐ **Examples** of capacitive loads are: capacitor banks, buried cables, capacitors used in various circuits such as motor starters.
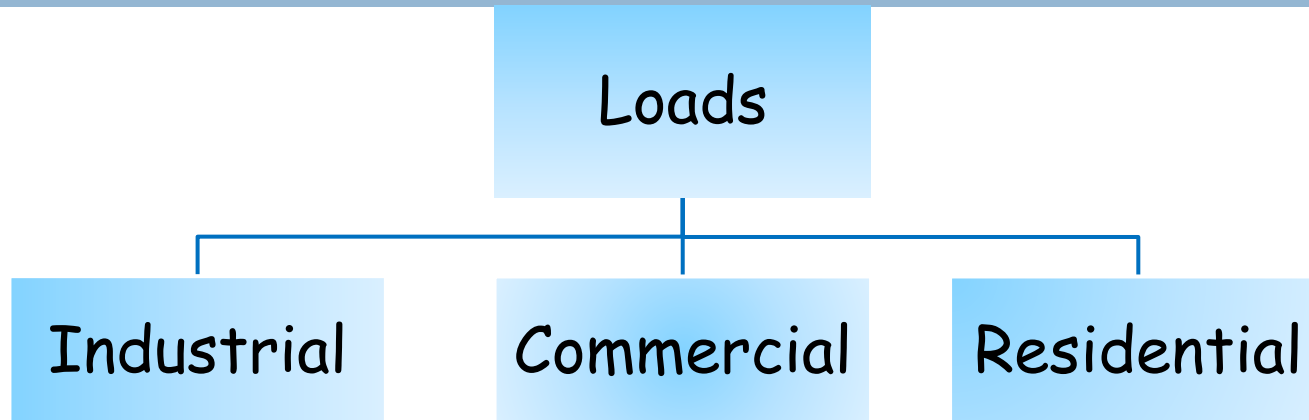
Prof. Mohamed Ahmed Ebrahim

3. Inductive Loads

□ An inductive load causes the current wave to lag the voltage wave. Thus, power factor of an inductive load is lagging.

□ Examples of inductive load include transformers, motors, and coils.

Prof. Mohamed Ahmed Ebrahim

4. Combination Loads

- Most of the loads are not purely resistive or purely capacitive or purely inductive. Many practical loads make use of various combinations of resistors, capacitors and inductors. Power factor of such loads is less than unity and either lagging or leading.

- **Examples:** Single phase motors often use capacitors to aid the motor during starting and running, tuning circuits or filter circuits.

Prof. Mohamed Ahmed Ebrahim

Types of loads in power system

```
                    ┌─────────────┐
                    │    Loads    │
                    └──────┬──────┘
          ┌────────────────┼────────────────┐
   ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
   │  Industrial  │ │  Commercial  │ │ Residential  │
   └──────────────┘ └──────────────┘ └──────────────┘
```

1. Very large industrial loads may be served from the transmission system.

2. Large industrial loads are served directly from the sub transmission network.

3. Small industrial loads are served from the primary distribution network.

Prof. Mohamed Ahmed Ebrahim

Cont.

➢ **Commercial and residential loads** consist largely of lighting, heating, and cooling. These loads are independent of frequency and consume negligibly small reactive power.

➢ **The industrial loads** are composite loads, and induction motors form a high proportion of these load. These composite loads are functions of voltage and frequency and form a major part of the system load.

Prof. Mohamed Ahmed Ebrahim

Cont.

➢ The magnitude of load varies throughout the day, and power must be available to consumers on demand.

➢ **The load factor** is the ratio of average load over designated period of time to the peak load occurring in that period.

$$\text{Daily L.F.} = \frac{\text{average load}}{\text{peak load}}$$

Prof. Mohamed Ahmed Ebrahim

residential loads

Coffee maker	900-1200 watts
Microwave	750-1100 watts
Toaster	800-1400 watts
Dishwasher	1200-2400 watts
Washer	350-500 watts
Dryer	1800-5000 watts
Iron	100-1800 watts
Ceiling fan	65-175 watts
Space heater (40gal)	4500-5500 watts
Hair dryer	1200-1875 watts
Laptop	50 watts
Computer monitor	150 watts
Computer tower	120 watts
Television 19"-36"	65-133 watts
Television 53"-61"	170 watts

Prof. Mohamed Ahmed Ebrahim

Example (1)

The daily load on a power system varies as shown in Table 1.2. Use the **barcycle** function to obtain a plot of the daily load curve. Using the given data compute the average load and the daily load factor (Figure 1.2).

Table 1.2 Daily System Load

Interval, hr			Load, MW
12 A.M.	—	2 A.M.	6
2	—	6	5
6	—	9	10
9	—	12	15
12 P.M.	—	2 P.M.	12
2	—	4	14
4	—	6	16
6	—	8	18
8	—	10	16
10	—	11	12
11	—	12 A.M.	6

Prof. Mohamed Ahmed Ebrahim

Solution (1)

□ The following data:

Interval, hr		Loads, MW
0	2	6
2	6	5
6	9	10
9	12	15
12	14	12
14	16	14
16	18	16
18	20	18
20	22	16
22	23	12
23	24	6

Sum (Dt) =
(2-0)+(6-2)+(9-6)+(12-9)+(14-12)+(16-14)+(18-16)+(20-16)+(22-20)+(23-22)+(24-23)=24

W = P * Dt=
6*(2-0)+5*(6-2)+10*(9-6)+15*(12-9)+12*(14-12)+14*(16-14)+16*(18-16)+18*(20-16)+16*(22-20)+12*(23-22)+6*(24-23)=277

P_{avg}= W / Sum(Dt)=
277/24=11.5417

P_{peak}= 18

Load Factor=P_{avg}/P_{peak}= (11.5417/ 18)=64.12

Prof . Mohamed Ahmed Ebrahim

Prices of electricity slots

٢٠١٩/٢٠١٨ (جنيه/مشترك/شهر)	الاستهلاك (ك.و.س/شهر)
٣٥,٠	جهد فائق، عالي ومتوسط
٤,٠	الري جهد منخفض
١٥,٠	استخدامات أخرى جهد منخفض
	الاستخدامات المنزلية
	الاستهلاك (ك.و.س/شهر)
١,٠	٥٠٠
٢,٠	٥١-١٠٠
٦,٠	١٠١-٢٠٠
١١,٠	٢٠١-٣٥٠
١٥,٠	٣٥١-٦٥٠
٢٥,٠	٦٥١-١٠٠٠
٤٠,٠	اكثر من ١٠٠٠
٩,٠	المقروء بصفر
	المحلات التجارية
	الاستهلاك (ك.و.س/شهر)
٥,٠	١٠٠
١٥,٠	١٠١-٢٥٠
٢٠,٠	٢٥١-٦٠٠
٢٥,٠	٦٠١-١٠٠٠
٤٠,٠	اكثر من ١٠٠٠
٩,٠	المقروء بصفر

Prof. Mohamed Ahmed Ebrahim

How to Calculate Your Electric Bill ?

☐ To calculate your electric bill, you'll need to figure the energy usage of each of the appliances and electronic devices in your home.

☐ **calculate the cost of use with this formula:**

1. Multiply the device's wattage by the number of hours that the appliance is used per day.

2. Divide by 1000.

3. Multiply by your kWh rate.

Prof. Mohamed Ahmed Ebrahim

Example (2)

□ *Suppose, a consumer consumes 1000 watts load per hour daily for one month. Calculate the total energy bill of the consumer if the unit rate is 9.*

Prof. Mohamed Ahmed Ebrahim

Solution (2)

- ❑ 1unit = 1kWh.

- ❑ So Total kWh = 1000 Watts x 24 Hrs x 30 Days = 720000 watts hour.

- ❑ We want to convert it into units, where is 1unit = 1kWh.
  So total consumed units. 720000/1000……
  (k=kilo=1000).
  Total units = 720.
  Cost per unit is 9.

- ❑ So total cost or electricity bill= 720 x 9 = 6480

Prof. Mohamed Ahmed Ebrahim