Topic

Unit -2

1. Power factor
2. Capacitor types • Placement of capacitor
3. HT supply and LT supply
4. Transformer working.
5. Cables
6. Harmonics
7. LEDs Applications
8. Energy saving in illumination
9. Power losses in electrical machines
10. ~~Power losses in el~~ Energy efficient motors
11. Introduction to electrical energy system and its components.

Unit 3

1. Air conditioner and refrigeration
2. Diesel generator
3. Energy efficiency
4. HVAC systems.
5. Fan and blowers
6. Pumps
7. Cooling tower.

- LT and HT supply.

LT

- LT lines stands for low tension lines.
- Conductors that carry electricity from the distribution transformer structure to the consumer house.
- LT line carries 440 volts line voltage (phase to phase) and 230 volts voltage (neutral to phase).
- Most small consumers of electricity like individual houses, shops small offices and small manufacturing units get their electricity on LT connection.
- The types of insulators used in low tension lines are pin insulator.
- In the LT line, four ~~characters~~ conductors are used such as 3 conductors for phase and one for neutral.

HT

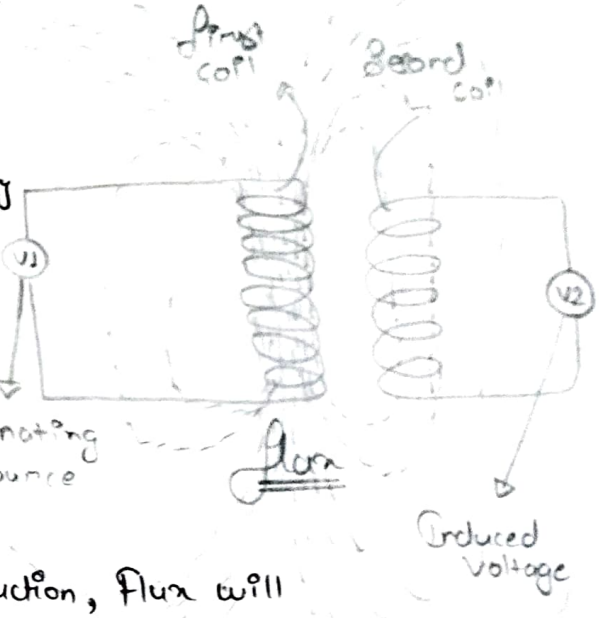
- High tension lines.
- Conductors that carry electricity from substation to distribution transformer.
- HT lines carries 11kV voltage.
- In the HT line, three conductors are used for phase (R, Y, B).
- Insulators used in high tension lines are pin insulators and disc insulators.
- HT lines are erected at main roads generally.
- In HT lines also PCC and RCC poles are used.
- In HT the erection cost of HT lines is more than that of LT line.

Transformer

- Is an static electromagnetic device that transfers electrical energy from one circuit to another circuit with change in voltage, keeping frequency constant.

Working of a Transformer

- Alternating voltage V_1 is applied to the primary winding, a current is stablished in the primary winding which produces a alternating flux in the core.
- Flux links with both primary and secondary windings.



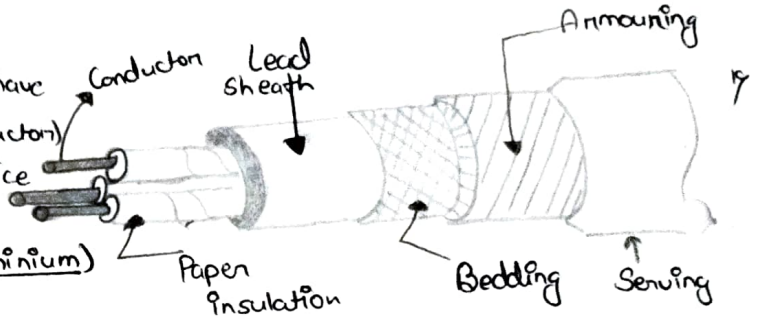
- As per Faraday law of electromagnetic induction, flux will cause a self induced EMF in primary and mutually induced EMF in secondary.
- Due to when a load is connected to secondary side, current will start flowing in the secondary winding due to induced emf.
- The voltage induced in secondary winding is responsible to deliver power to the load connected to it.
- Thus power is transfered from one circuit to another.

Chill!! that's all

Cable

An underground cable essentially consists of one or more conductors covered with suitable insulation and surrounded by a protective cover. he

Construction of cable



1. Cores or Conductors - A cable may have one or more than one core (conductor) depending upon the type of service for which it is inteded. (tinned copper or alluminium)

2. Insulation :-
Each core or conductor is provided with a suitable thickness of insulation, the thickness of layer depending on voltage.
Materials :- Impregnated paper, varnished cambric or rubber mineral compond.

3. Metallic sheath :- In order to protect from moisture, gasses or other damaging liquids (acid or alkalines).

4. Bedding :- Over the metallic sheath is applied a layer of bedding which consist of a fibrous material like jute or hessian tape. It is to protect material the metallic sheath

5. Armouring :- Consist of one or two layer of galvonished steel wire or steel tape.
Aims to protect cable from mechanical injury.

6. Serving :- In order to protect armouring from atmospheric conditions, a layer of fibrous material is used.

Harmonics

- Unwanted higher freq. component that is an integer multiple of the fundamental freq. Harmonics create a distortion in the fundamental waveform.
- The distortion of fundamental sinusoidal waveform supplied by any source is the harmonics in the electrical circuit.

Cause of Harmonics

- Harmonics are caused by the load like:-
  - -> Controlled rectifiers.
  - -> AC and DC variable speed drives.
  - -> Rectifier transformers.
  - -> Solid state heater control.
- Linear loads can cause harmonics during the starting.
- Capacitors switching also causes harmonics.
- The root cause of harmonics is the non-linear current drawn by the load even after applying linear voltage waveform

Need of Harmonics study and correction

- To prevent :-
  - a) Premature failure of power factor improving capacitors.
  - b) overheating of transformer.
  - c) " " source alternators.
- Harmonics in power systems results in ↑ heating in the equipment and conductors and create a pulsating torque in the motors.

LED

- A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flow through it.
- When current passes through an LED, the electrons recombine with holes emitting light in the process.
- LEDs allow the current to flow in the forward direction and blocks the current in reverse direction.
- Is a heavily doped p-n junctions.
- Based on the semiconductor material used and the amount of doping, an LED will emit a coloured light at a particular spectral wave length when forward biased.

LED Applications

- Camera flash light
- TV
- Smartphones
- Lighting - houses
- Traffic signal

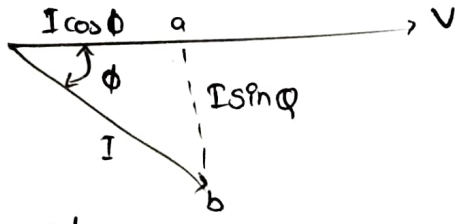
Energy Saving in Illumination.

1. Optimization of Industrial / Domestic lightning (LUX optimization)
2. optimal use of natural light.
3. Lightning control in Industrial - Lights can be shut off during non-working hours automatically.
4. Use of LED lamps.
5. Periodic survey and adequate maintenance program.

Power factor

- The cosine of angle b/w voltage and current in an ac circuit is known as power factor
- A circuit can be resistive, inductive on capacitive :-
  - if circuit is purely resistive, current will be <u>inphase</u> with voltage.
  - " " " " capacitive, " <u>will lead</u> voltage by 90 degree.
  - " " " " inductive, " <u>" lag</u> voltage by 90°.

Conside a inductive circuit



- I cosϕ is active or coattful component.
- I sinϕ is reactive or wattless component.
- The reactive component is measure of of the power factor.
- If reactive component is small => ϕ is small and hence power factor cosϕ will be high.
- Therefore, a circuit having small reactive current (I sinϕ) will have high <u>power factor</u> and vice-versa.

Power factor Improvement

- In order to improve the power factor, some device taking leading power should be connected in parallel with the load. One of such device can be capacitor.
- The capacitor draws a leading current and partly on completely neutralises the lagging reactive component of load current. This raises the power factor of the load.
- Normally power factor stays b/w 0.8 to 0.9.
- However, sometimes it is lower and in such cases it is generally desirable take special steps to improve the power factor.

① Static capacitor
② Synchronous condenson
③ phase Advancer

Static Capacitor :- Connecting capacitor in || with the equipment operating at lagging power factor will improve power factor.

- The capacitor draws a leading current and partly on completely neutralises the lagging reactive component of load current.
- This raises the power factor of the load.
- For 3-phase load, it can be connected in delta on star.

Advantage :- .low losses.
- can work under ordinary condn
- less maintainance.
- easy installation.

Disadvantage :- • short life 8 to 10 years
• easily damaged if voltage exceeds.

(2) Capacitor types

As per the structure, types of capacitors are

1. Fixed capacitors
2. Variable "
3. Trimmer "
4. Padder "

As per polarization, they are classified as:

1. Polarized capacitors
2. Unpolarized. "

Other types of capacitors

1. Ceramic capacitors
2. Film "
3. Power film "
4. Electrolytic "
5. Paper "

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9. Power losses in electrical Motors

- Motor loose energy when serving a load.

1. fixed loss
2. Rotor "
3. Stator "
4. Friction and rewinding
5. Stray load loss.

Energy Efficiency Electric Motors.

Factors that influence efficiency.

- Age
- Capacity
- Speed
- Type
- Temperature
- Rewinding
- Load.

Motor part load efficiency

- Designed for 50-100% load.
- Most efficient at 75% load.
- Rapid drop below 50% load.

- Motor load is indicator of efficiency
  - → equation to determine load.

$$P_i = \frac{V \times I \times PF \times \sqrt{3}}{1000}$$

where

P_i = Three-phase power in kW

V = RMS voltage, mean line-to line 3 phases

I = RMS current, mean of 3phases.

PF = Power factor as a decimal,