HARYANA STATE BOARD OF TECHNICAL EDUCATION

ELECTRICAL ENERGY CONSERVATION & MANAGEMENT (EECM)

Semester: 6th Semester

Branch: Electrical Engineering

Important questions with their answers:

Define Light?

Light may be defined as electromagnetic radiation that is capable of affecting the sense of sight.

Define Illumination or Illuminance and what is its unit?

Illumination is directly proportional to the luminous intensity of the source.

The illumination E of a surface A is defined as the luminous flux per unit area (F/A) in lumens per square meter which is renamed a lux.

$$E=F/A$$

This is the quotient of the illuminous flux incident on an element of the surface at a point of surface containing the point, by the area of that element.

The lighting level produced by a lighting installation is usually qualified by the illuminance produced on a specified plane. In most cases, this plane is the major plane of the tasks in the interior and is commonly called the working plane. The illuminance provided by an installation affects both the performance of the tasks and the appearance of the space.

Define Lux (lx)?

This is the illuminance produced by a luminous flux of one lumen, uniformly distributed over a surface area of one square metre. One lux is equal to one lumen per square meter.

Define Space/Height Ratio?

Spacing Height Ratio is defined as the **ratio** of the distance between adjacent luminaires (centre to centre), to their **height** above the working plane.

It is given by the ratio: horizontal distance between two lamps/ mounting height of lamps

Define Luminous Efficacy (lm/W)?

This is the ratio of luminous flux emitted by a lamp to the power consumed by the lamp. It is a reflection of efficiency of energy conversion from electricity to light form.

Explain the laws of illumination?

Factors Affecting Illumination

Assumption that the source is a point source, or is otherwise sufficiently far away from the surface:

1) E is directly proportional to the luminous intensity of the source.
2) Inverse Square Law
3) Lambert's Cosine Law Laws for Point Sources of Light

Laws for Point Sources of Light

The Inverse Square Law of Illuminance

Established by **J. H. Lambert** as one of the earliest lighting laws to enable the calculation of illuminance

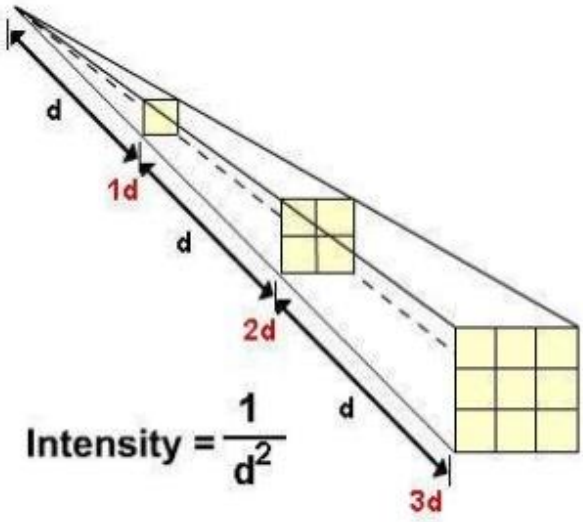
This law states that the Illuminance (E) at any point on a plane perpendicular to the line joining the point and source is inversely proportional to the square of the distance between the source and plane.

$$E = \frac{I}{d^2}$$

•Intensity of Illumination produced by a point source varies inversely as square of the distance from the source.

$$E = \frac{I}{d^2}$$

•Where, I is intensity and
•d is Distance



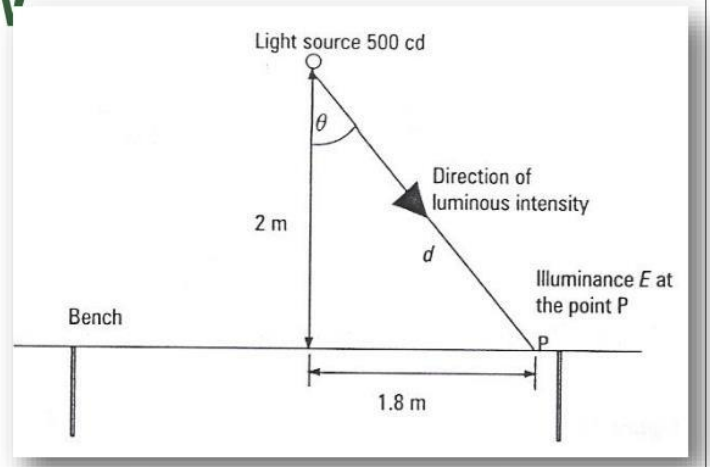
The Cosine Law of Illuminance

The law states that Illuminance at a point on a plane is proportional to the cosine of the angle of light incident (the angle between the direction of the incident light and the normal to the plane).

COSINE LAW

If a beam of light from a lamp hits a surface at an angle, the illuminated area increases but the illuminance on the surface is lower than when the light is pointed directly at the surface..

This is known as the COSINE LAW and is shown by the expression:



$$E = \frac{I}{d^2} \times \mathrm{Cos}\,\theta$$

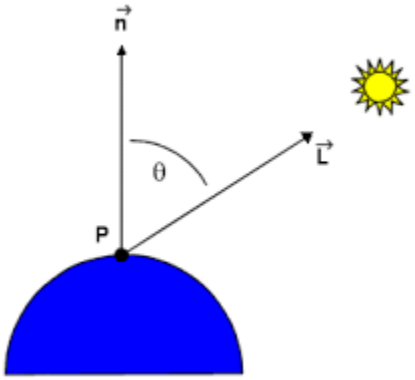


Figure: Sun rays inclined on earth

What is Tariff?

The rate at which electrical energy is supplied to a consumer is known as **tariff**.

Although tariff should include the total cost of producing and supplying electrical energy plus the profit, yet it cannot be the same for all types of consumers. It is because the cost of producing electrical energy depends to a considerable extent upon the magnitude of electrical energy consumed by the user and his load conditions. Therefore, in all fairness, due consideration has to be given to different types of consumers (*e.g*., industrial, domestic and commercial) while fixing the tariff. This makes the problem of suitable rate making highly complicated.

What are the Objectives of tariff?

Like other commodities, electrical energy is also sold at such a rate so that it not only returns the cost but also earns reasonable profit. Therefore, a tariff should include the following items :

(*i*) Recovery of cost of producing electrical energy at the power station.

(*ii*) Recovery of cost on the capital investment in transmission and distribution systems.

(*iii*) Recovery of cost of operation and maintenance of supply of electrical energy *e.g*., metering equipment, billing etc.

(*iv*) A suitable profit on the capital investment.

What are the desirable Characteristics of a Tariff

A tariff must have the following desirable characteristics:

(*i*) *Proper return*: The tariff should be such that it ensures the proper return from each consumer. In other words, the total receipts from the consumers must be equal to the cost of producing and supplying electrical energy plus reasonable profit. This will enable the electric supply company to ensure continuous and reliable service to the consumers.

(*ii*) *Fairness*: The tariff must be fair so that different types of consumers are satisfied with the rate of charge of electrical energy. Thus a big consumer should be charged at a lower rate than a small consumer. It is because increased energy consumption spreads the fixed charges over a greater number of units, thus reducing the overall cost of producing electrical energy. Similarly, a consumer whose load conditions do not deviate much from the ideal (*i.e*., non-variable) should be charged at a lower* rate than the one whose load conditions change appreciably from the ideal.

(*iii*) *Simplicity*: The tariff should be simple so that an ordinary consumer can easily understand it. A complicated tariff may cause an opposition from the public which is generally distrustful of supply companies.

(*iv*) *Reasonable profit*: The profit element in the tariff should be reasonable. An electric supply company is a public utility company and generally enjoys the benefits of monopoly. Therefore, the investment is relatively safe due to non-competition in the market. This calls for the profit to be restricted to 8% or so per annum.

(*v*) *Attractive*: The tariff should be attractive so that a large number of consumers are encouraged to use electrical energy. Efforts should be made to fix the tariff in such a way so that consumers can pay easily.

Explain the different types of Tariff and their advantages and disadvantages?

There are several types of tariff. However, the following are the commonly used types of tariff :

1. Simple tariff. *When there is a fixed rate per unit of energy consumed, it is called a* **simple tariff** *or* **uniform rate tariff.**

In this type of tariff, the price charged per unit is constant *i.e.*, it does not vary with increase or decrease in number of units consumed. The consumption of electrical energy at the consumer's terminals is recorded by means of an energy meter. This is the simplest of all tariffs and is readily understood by the consumers.

Disadvantages

(*i*) There is no discrimination between different types of consumers since every consumer has to pay equitably for the fixed charges.

(*ii*) The cost per unit delivered is high.

(*iii*) It does not encourage the use of electricity.

2. Flat rate tariff. *When different types of consumers are charged at different uniform per unit rates, it is called a* **flat rate tariff**.

In this type of tariff, the consumers are grouped into different classes and each class of consumers is charged at a different uniform rate. For instance, the flat rate per kWh for lighting

load may be 60 paise, whereas it may be slightly less (say 55 paise per kWh) for power load. The different classes of consumers are made taking into account their diversity and load factors. The advantage of such a tariff is that it is more fair to different types of consumers and is quite simple in calculations.

Disadvantages

(*i*) Since the flat rate tariff varies according to the way the supply is used, separate meters are required for lighting load, power load etc. This makes the application of such a tariff expensive and complicated.

(*ii*) A particular class of consumers is charged at the same rate irrespective of the magnitude of energy consumed. However, a big consumer should be charged at a lower rate as in his case the fixed charges per unit are reduced.

3. Block rate tariff. *When a given block of energy is charged at a specified rate and the succeeding blocks of energy are charged at progressively reduced rates, it is called a* **block rate tariff**.

In block rate tariff, the energy consumption is divided into blocks and the price per unit is fixed in each block. The price per unit in the first block is the highest and it is progressively reduced for the succeeding blocks of energy. For example, the first 30 units may be charged at the rate of 60 paise per unit; the next 25 units at the rate of 55 paise per unit and the remaining additional units may be charged at the rate of 30 paise per unit.

The advantage of such a tariff is that the consumer gets an incentive to consume more electrical energy. This increases the load factor of the system and hence the cost of generation is reduced. However, its principal defect is that it lacks a measure of the consumer's demand. This type of tariff is being used for majority of residential and small commercial consumers.

4. Two-part tariff. *When the rate of electrical energy is charged on the basis of maximum demand of the consumer and the units consumed, it is called a* **two-part tariff**.

In two-part tariff, the total charge to be made from the consumer is split into two components *viz*., fixed charges and running charges. The fixed charges depend upon the maximum demand of the consumer while the running charges depend upon the number of units consumed by the consumer. Thus, the consumer is charged at a certain amount per kW of maximum†† demand plus a certain amount per kWh of energy consumed *i.e*.,

Total charges = Rs ($b \times$ kW + $c \times$ kWh)
where, b = charge per kW of maximum demand
c = charge per kWh of energy consumed
This type of tariff is mostly applicable to industrial consumers who have appreciable maximum demand.

Advantages
(*i*) It is easily understood by the consumers.
(*ii*) It recovers the fixed charges which depend upon the maximum demand of the consumer but are independent of the units consumed.

Disadvantages
(*i*) The consumer has to pay the fixed charges irrespective of the fact whether he has consumed or not consumed the electrical energy.
(*ii*) There is always error in assessing the maximum demand of the consumer.

5. Maximum demand tariff: It is similar to two-part tariff with the only difference that the maximum demand is actually measured by installing maximum demand meter in the premises of the consumer. This type of tariff is mostly applied to big consumers. However, it is not suitable for a small consumer (*e.g*., residential consumer) as a separate maximum demand meter is required.

6. Three-part tariff. *When the total charge to be made from the consumer is split into three parts viz., fixed charge, semi-fixed charge and running charge, it is known as a* **three-part tariff**. *i.e*.,

Total charge = Rs ($a + b \times \text{kW} + c \times \text{kWh}$)

where a = fixed charge made during each billing period. It includes interest and depreciation on the cost of secondary distribution and labour cost of collecting revenues,

b = charge per kW of maximum demand,

c = charge per kWh of energy consumed.

It may be seen that by adding fixed charge or consumer's charge (*i.e.*, a) to two-part tariff, it becomes three-part tariff. The principal objection of this type of tariff is that the charges are split into three components. This type of tariff is generally applied to big consumers.

What is Maximum demand?

Maximum demand is the greatest demand of load on the power station during a given period.

The load on the power station varies from time to time. The maximum of all the demands that have occurred during a given period (*say* a day) is the maximum demand. Maximum demand is generally less than the connected load because all the consumers do not switch on their connected load to the system at a time. The knowledge of maximum demand is very important as it helps in determining the installed capacity of the station. The station must be capable of meeting the maximum demand.

Differentiate between 'contract demand' and 'maximum demand'?

Contract demand is the amount of electric power that a customer demands from utility in a specified interval (Unit used is kVA or kW) while the maximum kW and or kVA requirement over a billing cycle is called as maximum demand.

Differentiate the terms 'specific heat' and 'heat capacity'?

Specific heat is defined as the quantity of heat required to raise the temperature of 1 kg of a substance through 1 °C. Heat capacity is defined as the quantity of heat required to raise the temperature of the object by 1 °C.

Explain the terms fusion, melting point and vaporization of a substance?

The change of state from the solid state to a liquid state is called fusion. The fixed temperature at which a solid changes into a liquid is called its melting point. The change of a state from a liquid state to a gas is called vaporization.

Define 'latent heat of fusion' and 'latent heat of vaporization'?

Latent heat of fusion (L) of a substance is the quantity of heat required to convert 1 kg of solid to liquid state without change of temperature.

Latent heat of vaporization (L) of a substance is the quantity of heat required to change 1 kg of the substance from liquid to vapor state without change of temperature.

What is heat transfer? Briefly explain three primary modes of heat transfer.

The rate of energy transfer is called heat transfer.
Heat is transferred by three primary modes:

- Conduction (Energy transfer in a solid)
- Convection (Energy transfer in a fluid)
- Radiation (Does not need a material to travel through)

Conduction

The conduction of heat takes places, when two bodies are in contact with one another. If one body is at a higher temperature than the other, the motion of the molecules in the hotter body will agitate the molecules at the point of contact in the cooler body and consequently result in increase in temperature.

Convection

The transfer of heat by convection involves the movement of a fluid such as a gas or liquid from the hot to the cold portion.

Thermal Radiation

Thermal radiation is a process in which energy is transferred by electromagnetic waves similar to light waves. These waves may be both visible (light) and invisible.

What are the requirements for good or proper lighting?

Some requirements of good lighting are:

1. **Sufficiency:** The first point is sufficiency of lighting. Light need to be sufficient to see objects properly. Insufficient lighting cause to eye strain

2. **Distribution:** The second point is distribution of light. The efficient vision without any eye stress is occurs by uniformity in light distribution.

3. **Absence of glare:** The third point is Absence of glare. What you mean by glare? Glare is high contrast of light. There should be excessive light and high intensity of light cause to glare. For example; Torch lights. These lights are pointed and cause to glare. It is not possible to our eye for effective reading in glared light.

4. **Absence of sharp shadows:** The fourth point is about shadows. Shadows occur when any object takes place between the light source and field of vision. Shadows create stress and need to be clear for proper reading process. For example: Incandescent bulbs, it always causes to create shadiness but, florescent bulbs are proper to avoid shadows and effective reading.

5. **Steadiness:** The fifth point is steadiness. The term refers to stable condition of light. Light must be constant with constant contrast and constant intensity. Flickering lights are creating eyestrain and headache.

6. **Color of light:** The sixth point is color of light. Is there any problem by using colored light? Yes, if you use red or violet lights the effective reading will not take place. Because of the intensity of these lights are high than normal light. Day light is the sufficient illumination needed by eye to fulfill reading process. Artificial lights need to be like daylight contrast.

7. **Surroundings:** The seventh point is surrounding. The term refers to background field of vision. As a requirement to good lighting background has a major role. The walls in your rooms and ceilings are creates reflection and its essential to accumulation of light. If you use glass walls or black backgrounds the efficiency of light should lost. Because glass walls emit the light outside and black background absorbs the light and don't possible reflection. So, surrounding should be in a normal condition by using proper materials cause to reflection.

8. **Angle of light:** The eighth point is angle of lighting. Light source should be established in a proper way that lead to effective lighting by reflection. If the light is established in an improper condition there should not reflection and the efficiency will lost. For effective reading light source is better to establish in left side wall than ceiling and other sides.

Write some good practices in lighting?

Some Good Practices in Lighting

Installation of energy efficient fluorescent lamps in place of "Conventional" fluorescent lamps

Energy efficient lamps are based on the highly sophisticated tri-phosphor fluorescent powder technology. They offer excellent colour rendering properties in addition to the very high luminous efficacy.

Installation of Compact Fluorescent Lamps (CFL's) in place of incandescent lamps

Compact fluorescent lamps are generally considered best for replacement of lower wattage incandescent lamps. These lamps have efficacy ranging from 55 to 65 lumens/Watt. The average rated lamp life is 10,000 hours, which is 10 times longer than that of a normal incandescent lamps. CFL's are highly suitable for places such as Living rooms, Hotel lounges, Bars, Restaurants, Pathways, Building entrances, Corridors, etc.

Installation of metal halide lamps in place of mercury / sodium vapour lamps

Metal halide lamps provide high color rendering index when compared with mercury & sodium vapour lamps. These lamps offer efficient white light. Hence, metal halide is the choice for colour critical applications where, higher illumination levels are required. These lamps are highly

suitable for applications such as assembly line, inspection areas, painting shops, etc. It is recommended to install metal halide lamps where colour rendering is more critical.

Installation of High Pressure Sodium Vapour (HPSV) lamps for applications where colour rendering is not critical.

High pressure sodium vapour (HPSV) lamps offer more efficacy. But the colour rendering property of HPSV is very low. Hence, it is recommended to install HPSV lamps for applications such street lighting, yard lighting, etc.

Installation of LED panel indicator lamps in place of filament lamps

Panel indicator lamps are used widely in industries for monitoring, fault indication, signaling, etc. Conventionally filament lamps are used for the purpose, which has got the following disadvantages:

- High energy consumption (15 W/lamp)
- Failure of lamps is high (Operating life less than 1,000 hours)
- Very sensitive to the voltage fluctuations Recently, the conventional filament lamps are being replaced with Light Emitting Diodes (LEDs).

The LEDs have the following merits over the filament lamps.

- Lesser power consumption (Less than 1 W/lamp)
- Withstand high voltage fluctuation in the power supply.
- Longer operating life (more than 1,00,000 hours)

It is recommended to install LEDs for panel indicator lamps at the design stage.

Light distribution

Energy efficiency cannot be obtained by mere selection of more efficient lamps alone. Efficient luminaires along with the lamp of high efficacy achieve the optimum efficiency. Mirror-optic luminaires with a high output ratio and bat-wing light distribution can save energy.

For achieving better efficiency, luminaires that are having light distribution characteristics appropriate for the task interior should be selected. The luminaires fitted with a lamp should ensure that discomfort glare and veiling reflections are minimised. Installation of suitable luminaires, depends upon the height - Low, Medium & High Bay. Luminaires for high intensity discharge lamp are classified as follows:

- Low bay, for heights less than 5 metres.
- Medium bay, for heights between 5 – 7 metres.
- High bay, for heights greater than 7 metres.

System layout and fixing of the luminaires play a major role in achieving energy efficiency. This also varies from application to application. Hence, fixing the luminaires at optimum height and usage of mirror optic luminaries leads to energy efficiency.

Light Control

The simplest and the most widely used form of controlling a lighting installation is "On-Off" switch. The initial investment for this set up is extremely low, but the resulting operational costs may be high. This does not provide the flexibility to control the lighting, where it is not required.

Hence, a flexible lighting system has to be provided, which will offer switch-off or reduction in lighting level, when not needed. The following light control systems can be adopted at design stage:

- **Grouping of lighting system, to provide greater flexibility in lighting control**

Grouping of lighting system, which can be controlled manually or by timer control.

- **Installation of microprocessor based controllers**

Another modern method is usage of microprocessor / infrared controlled dimming or switching circuits. The lighting control can be obtained by using logic units located in the ceiling, which can take pre-programme commands and activate specified lighting circuits. Advanced lighting control system uses movement detectors or lighting sensors, to feed signals to the controllers.

- **Optimum usage of daylighting**

Whenever the orientation of a building permits, day lighting can be used in combination with electric lighting. This should not introduce glare or a severe imbalance of brightness in visual environment. Usage of day lighting (in offices/air conditioned halls) will have to be very limited, because the air conditioning load will increase on account of the increased solar heat dissipation into the area. In many cases, a switching method, to enable reduction of electric light in the window zones during certain hours, has to be designed.

- **Installation of "exclusive" transformer for lighting**

In most of the industries, lighting load varies between 2 to 10%. Most of the problems faced by the lighting equipment and the "gears" is due to the "voltage" fluctuations. Hence, the lighting equipment has to be isolated from the power feeders. This provides a better voltage regulation for the lighting. This will reduce the voltage related problems, which in turn increases the efficiency of the lighting system.

- **Installation of servo stabilizer for lighting feeder**

Wherever, installation of exclusive transformer for lighting is not economically attractive, servo stabilizer can be installed for the lighting feeders. This will provide stabilized voltage for the lighting equipment. The performance of "gears" such as chokes, ballasts, will also improved due to the stabilized voltage.

This set up also provides, the option to optimise the voltage level fed to the lighting feeder. In many plants, during the non-peaking hours, the voltage levels are on the higher side. During this period, voltage can be optimised, without any significant drop in the illumination level.

- **Installation of high frequency (HF) electronic ballasts in place of conventional ballasts**

New high frequency (28–32 kHz) electronic ballasts have the following advantages over the traditional magnetic ballasts: Energy savings up to 35% Less heat dissipation, which reduces the air conditioning load • Lights instantly • Improved power factor • Operates in low voltage load • Less in weight • Increases the life of lamp The advantage of HF electronic ballasts, out weigh the initial investment (higher costs when compared with conventional ballast). In the past the failure rate of electronic ballast in Indian Industries was high. Recently, many manufacturers have

improved the design of the ballast leading to drastic improvement in their reliability. The life of the electronic ballast is high especially when, used in a lighting circuit fitted with a automatic voltage stabiliser.

What is Energy Management and its objectives?

Energy Management

"The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems"

Objective of Energy Management

- To achieve and maintain optimum energy procurement and utilisation, throughout the organization
- To minimise energy costs / waste without affecting production & quality
- To minimise environmental effects.

What is Energy Audit and its objectives?

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions. Industrial energy audit is an effective tool in defining and pursuing comprehensive energy management programme.

Definition of Energy Audit under the Energy Conservation Act, 2001

As per the Energy Conservation Act, 2001, an **energy audit is defined as "the verification, monitoring and analysis of use of energy including submission of a technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption."**

Objectives

- How Much Energy Is Used?

- Where Is Energy Consumed?
- How Is It Used?
- How Can We Reduce Cost/ Consumption?
- How to Estimate Losses / Reduce Losses?
- Benchmarking For Various Processes/Systems?

What are the different types of Energy Audit?

There are several types of energy audits. These are listed below in order of increasing scope and, therefore, cost:

1. Preliminary Audit,
2. Utility Cost Analysis,
3. Standard Energy Audit, and
4. Detailed Energy Audit

1. Preliminary Energy Audit

This is the simplest and quickest type of audit. **Preliminary energy audit** uses existing or easily obtainable data. It usually involves a one day site visit to collect an overall facility profile and information on major energy using systems and equipment. It includes minimal interviews with site operating personnel, a brief review of facility bills and other data. A walk-through of the facility is also done to become familiar with the operation and to identify any glaring areas of inefficiency.

2. Utility Cost Analysis

The purpose of this type of audit is to analyze the operating costs of the facility, and determine the potential for energy efficiency retrofits. The auditor may also perform a preliminary audit to familiarize himself/herself with the facility. Utility data and the facility's utility bills are analyzed for the past several years to **identify patterns of energy use**, **peak demand**, and **weather effects**. This information is used **to identify energy savings potential**, **calculate the energy utilization index, and determine the incremental cost of each unit of energy**.

3. Standard Energy Audit

This audit provides a comprehensive analysis of the energy systems of a facility. It **includes both a preliminary audit and utility cost analysis**. In addition, the standard energy audit **includes the establishment of baseline energy use, evaluation of energy measures in terms of energy and cost savings and cost effectiveness**.

4. Detailed Energy Audit

The detailed audit, also called a maxi audit, site-energy audit or complete site energy audit, expands on the preliminary audit. It is carried out by collecting more detailed information about the operation and performing a more detailed evaluation of energy conservation measures.

The purpose of a detailed audit is to identify specific recommendations and make suggestions for energy savings. This type of audit offers the most accurate estimate of energy savings and costs. It accounts for the energy use of all major equipment and operations, and includes detailed cost saving calculations and project cost. It can be used to formulate action plans for the implementation of these recommendations based on the investment required, payback period, cost benefit ratio, etc.

Write the methodology of an Energy Audit?

The various steps in the methodology for conducting a detailed energy audit for an industry may be outlined as follows:

1. Gathering and collating information in a specially designed, “Energy Systems Questionnaire” format, for the industry under study.
2. Inter- and intra-industry comparison of the collected data.
3. Assessment of present efficiency index for energy consumption in the industry/process.
4. In-depth study of plant operations, equipment and systems for a general review of the energy systems to assess the operational efficiency and potential for economising.
5. Evaluation of the detailed recommendations for energy saving/conservation,
6. Formulation of detailed action plans/strategies in consultation with plant management for implementation of the identified energy saving measures.

7. Training operating personnel in the specifics of energy conservation to enable them to implement the recommendations and also to monitor the progress on a periodic basis.

Write some energy saving tips for Lighting System?

1. Turn off lights when not required.
2. Fluorescent tube lights and CFLs convert electricity to visible light up to 5 times more efficiently than ordinary bulbs and also save about 70% of electricity for the same lighting levels.
3. Use electronic chokes in place of conventional copper chokes. Electronic ballasts can reduce power consumption by 20%.
4. Consider employing infrared sensors, motion sensors, automatic timers, dimmers and solar cells wherever applicable, to switch on/off lighting circuits.
5. Compact fluorescent bulbs are four times more energy efficient than incandescent bulbs and provide the same lighting. 90% of the energy consumed by an ordinary bulb (incandescent lamp) is given off as heat rather than visible light.
6. Use task lighting, which focuses light where's it's needed. A reading lamp, for example, lights only reading material rather than the whole room.
7. Dirty tube lights and bulbs reflect less light and can absorb 50% of the light; dust your tube lights and lamps regularly.
8. De-dust lighting fixtures to maintain illumination

Write some energy saving tips for Ovens / Microwave Oven?

1. Microwaves use around 50% less energy than conventional ovens: they're most efficient for small portions or defrosting.

2. Check the seal on your oven door to see if there are cracks or tears in it.

3. Develop the habit of “lids-on” cooking to permit lower temperature settings.

4. Carefully measure water used for cooking to avoid having to heat more than is needed.

5. Begin cooking on highest heat until liquid begins to boil. Then lower the heat control settings and allow food to simmer until fully cooked.

6. Rearrange oven shelves before turning your oven on – and don't peep at food in the oven. Every time you open the oven door, 4°-5° is lost.

7. When preheating an oven for baking, note preheat period carefully. Five to eight minutes should be sufficient.
8. For large items, stove-top cooking is most efficient, especially with gas.
9. Microwaves cook food from the outside edge toward the centre of the dish, so if you're cooking more than one item, place larger and thicker items on the outside.

Write some energy saving tips for washing machine?

1. Washing machines can account for as much as 20% of the electricity you use.
2. Use Cold water, as almost 90% of the energy consumed by washing machines goes to heating the water. Set the washing machine temperature to cold or warm and the rinse temperature to cold as often as possible.
3. Each was cycle uses up to 60 to 90 litres of water. Use washing machine on full load and plan washing periodicity to save on water too.
4. Use the correct amount of detergent. Adding too much detergent actually hampers effective washing action and may require more energy in the form of extra rinses.
5. Wash only full loads of clothing-but do not overload machine. Sort laundry and schedule washes so that a complete job can be done with a few cycles of the machine carrying its full capacity, rather than a greater number of cycle with light loads.
6. Soak or pre-wash the cloths for effective cleaning.
7. Use optimal quantity of water
8. Use timer facility to save energy

What is Energy Conservation Building Code (ECBC)?

Energy Conservation Building Code (ECBC)

- Specifies standards for new, large, energy –efficient commercial buildings.
- Energy Service Companies (ESCOs)
- Upgrade the energy efficiency of existing government buildings through retrofitting on performance contracting mode.

The Star Rating Program for buildings is based on actual performance of the building in terms of specific energy usage (kWh/sq m/year).

This programme would rate office buildings on a 1-5 Star scale with 5 Star labeled buildings being the most efficient.

Five categories of buildings - office buildings, hotels, hospitals, retail malls, and IT Parks in five climate zones in the country have been identified.

What is Energy Conservation Act, 2001?

Energy Conservation Act, 2001

- Considering the vast potential of energy savings and benefits of energy efficiency, the Government of India enacted the **Energy Conservation Act in 2001**.
- The Act provides for the **legal framework**, institutional arrangement and a regulatory mechanism at the Central and State level for energy efficiency in the country.
- It called for the creation of **Bureau of Energy Efficiency (BEE**) at the central level to facilitate the implementation of the EC Act.
- The Act provides regulatory mandate for: standards & labelling of equipment and appliances; energy conservation building codes for commercial buildings; energy consumption norms for energy intensive industries ; and Establishment of Energy Conservation Fund (both at center and state)

What is Bureau Of Energy Efficiency (BEE)?

Bureau of Energy Efficiency (BEE)

- It is a statutory body **established in 2002**, under the Energy Conservation Act, 2001.
- It functions under the Ministry of Power.
- **Mandate**: It facilitates the implementation of the EC Act by developing policies and strategies which focus on the primary objective of reducing energy intensity of the Indian economy.
- It is responsible for spearheading the improvement of energy efficiency of the economy through various regulatory and promotional instruments

- It coordinates with State level agencies and energy consumers to perform functions and exercise powers that may be necessary for efficient use of energy and its conservation in India.
- The members of the governing council of the bureau are appointed by the central government.
- Minister of power shall be the ex-officio chairman of the bureau.

Star Labelled Appliances

Energy 'labeling' is one of the most cost effective policy tools for improving energy efficiency and lowering energy cost of appliances/equipment for the consumers. The program has been developed in a collaborative and consensus driven approach with active participation from all the stakeholders.

What is Standards?

1. Prescribe limits on the energy consumption (or minimum levels of the energy efficiency) of manufactured products.
2. "Standards" commonly encompasses two possible meanings:
3. well-defined test protocols to obtain a sufficiently accurate estimate
4. target limits on energy performance

What is Label?

1. Describes energy performance (in the form of energy use, efficiency or energy cost)
2. "Labels" mainly give consumers the necessary information to make informed purchase. There are two types of labels:

Comparative Label	Endorsement Label
Allow consumers to compare the energy consumption of similar products, and factor lifetime running cost into their purchasing decision	Provide a 'certification' to inform prospective purchasers that the product is highly energy efficient for its category.

Energy labels can be used stand alone or complement energy standards. In addition to giving information that allows consumers who care to select efficient models, labels also provide a common energy-efficiency benchmark that can work in association with other policy measures such as procurement programs, financial incentives etc. The effectiveness of energy labels is heavily dependent on how they present information to the consumer and on how they are supported by information campaigns, financial incentives, and other related programs.

A star rating, ranging from 1 to 5 in the ascending order of energy efficiency is provided to products registered with the Bureau.

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