INSPIREEE

INSPIRATIONAL SCRIPTS, PERSONALITIES AND INNOVATIVE RESEARCH

NEWSLETTER/ EEE/ VOLUME 5: ISSUE 4- APRIL 2017







K.L.N. COLLEGE OF ENGINEERING

Department of Electrical and Electronics Engineering

(4th time Accredited by NBA, New Delhi)

Approved by AICTE and Afflicated to Anna University
An ISO 9001:2008 Certified Institution
Pottapalayam - 630 612, Sivagangai Dt., Tamilnadu.

INSPIREEE

INspirational **S**cripts, **P**ersonalities and **I**nnovative **R**esearch of **EEE**

VISION

To become a high standard of excellence in Education, Training and Research in the field of Electrical and Electronics Engineering and allied applications

MISSION

To Produce excellent, innovative and Nationalistic Engineers with Ethical values and to advance in the field of Electrical and Electronics Engineering and Allied Areas

K.L.N. College of Engineering

Pottapalayam – 630 612, Sivagangai District, Tamil Nadu, India

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MESSAGE FROM HEAD OF THE DEPARTMENT

Dr. S.M. KANNAN, M.E. Ph.D.,

FIE, MISTE, MIEEE (USA)

Professor & Head, EEE,

K.L.N. College of Engineering

MESSAGE

Greetings,

I am very happy to inform that the EEE Department got Accredited, 4th time by NBA, New Delhi and this is valid up to 30.6. 2019. It is a very prestigious moment for us. I wish to thank, in this occasion, all the well-wishers of KLNCE-EEE for their kind support and valuable assistance.

Issues 3 and 4 have been nicely prepared starting with beautiful cover page. Topics focusing latest trends in EEE filed covering FACTS, Smart Grid etc., are well informed. The articles by Final year students show their dedicated work, presenting the material in a nice manner, and their depth of knowledge. The fourth issue is focusing on social impact of Electrical field. Their presentation is also very good. Engineers should develop such writing skills, once they reached the quality, they are the expert. Engineers can acquire the best of their writing skills by reading Novels, Newspapers and watching best Hollywood movies. Once they develop such skills, their writing will like a thriller, everyone love to read, and thereby the reader get benefitted. Students can claim later, anywhere about their contribution on the work they submitted for the Newsletter. I thank the contributors of this issue for publishing as per the schedule. Best wishes to all.

Dr. S.M. KANNAN

Head of the Department - EEE

EDITORIAL CREW

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MUTHUMATHI T (132023/ IV Year B Section)

Basic economics of transmission and distribution

Saranya (152061)-2nd-YEAR- 'C'Sec

In most industrialized countries, electric power is provided by generating facilities, known as central station generators, are often located in remote areas, far from the point of consumption. The economics of central station generation is largely a matter of costing. As with any other production technology, central station generation entails fixed and variable costs. The fixed costs are relatively straightforward, but the variable cost of power generation is remarkably costs of power generation.

The fixed costs of power generation are essentially capital costs and land. The capital cost of building central station generators vary from region to region, largely as a function of labor costs and "regulatory costs," which include things like obtaining siting permits, environmental approvals, and so on. It is important to realize that building central station generation takes an enormous amount of time.

In a state, such as Texas, the time-to-build can be as short as two years. In California, where bringing new energy infrastructure to fruition is much more difficult (due to higher regulatory costs), the time-to-build can exceed ten years. Table 5.1 shows capital cost ranges for several central-station technologies. Although the ranges in Table 5.1 are quite wide, they still mask quite a bit of uncertainty in the final cost of erecting power plants.

Operating costs for power plants include fuel, labor and maintenance costs. Unlike capital costs which are "fixed" (don't vary with the level of output), a plant's total operating cost depends on how much electricity the plant produces. The operating cost required to produce each MWh of electric energy is referred to as the "marginal cost." Fuel costs dominate the total cost of operation for fossil-fired power plants. For renewables, fuel is generally free (perhaps with the exception of biomass power plants in some scenarios); and the fuel costs for nuclear power plants are actually very low. For these types of power plants, labor and maintenance costs dominate total operating costs. Further, generators which run on fossil fuels tend to have operating costs that are extremely sensitive to changes in the underlying fuel price.

DIASTER MANAGEMENT

V.Vivitha (132030), Final Year, EEE-B

Disaster management is the creation of plans through which communities reduce vulnerability to hazards and cope with disasters. Disaster management does not avert or eliminate the threats; instead, it focuses on creating plans to decrease the effect of disasters. Failure to create a plan could lead to human mortality, lost revenue, and damage to assets. Currently in the United States 60 percent of businesses do not have emergency management plans. Events covered by disaster management include acts of terrorism, industrial sabotage, fire, natural disasters (such as earthquakes, hurricanes, etc.), public disorder, industrial accidents, and communication failures.

RESEARCH

The Centre for Disaster Management and Public Safety aims to facilitate and enable research collaborations, projects and engagement leading to an increased understanding of disaster, risk and resilience trends, challenges and solutions. One of the key objectives of the research program is to use a multi-disciplinary approach to create a knowledge base that can be used to support further research activity, training and education programs.

RESEARCH PRIORITY AREAS

The Centre has identified through consultation with key stakeholders and an analysis and review of studies conducted on major disaster events, six key priority areas. These key areas reflect the research that is considered to be critical in enhancing disaster management practice and policy over the next three years.

RECENT

The recent oil spill off the Chennai coast makes this painfully obvious The Chennai oil spill which occurred after a collision between two tankers at the Kamraj Port in Ennore brings back into sharp focus India's preparation to handles disasters from its port developments. Coast Guard has repeatedly brought up the need of Local Contingency Plans (LCPs) for the proper functioning of the national plan National Oil Spill Disaster Contingency Plan.

The National Oil Spill Disaster Contingency Plan (NOS DCP) was adopted way back in 1996. The plan has been reviewed and revised periodically to reflect international safety standards and provisions according to the Union Ministry of Shipping and Indian Coast Guard, in charge of oversight and implementation.

Disaster Risk Reduction can take place in the following ways:

1. Preparedness

This protective process embraces measures which enable governments, communities and individuals to respond rapidly to disaster situations to cope with them effectively. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories and the training of personnel. It may also embrace search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster. Preparedness therefore encompasses those measures taken before a disaster event which are aimed at minimizing loss of life, disruption of critical services, and damage when the disaster occurs.

2. Mitigation

Mitigation embraces measures taken to reduce both the effect of the hazard and the vulnerable conditions to it in order to reduce the scale of a future disaster. Therefore, mitigation activities can be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures which are hazard specific include water management in drought prone areas, relocating people away from the hazard prone areas and by strengthening structures to reduce damage when a hazard occurs. In addition to these physical measures, mitigation should also aim at reducing the economic and social vulnerabilities of potential disasters.

DIASTER MANAGEMENT IN ELECTRICAL ENGINEERING

A. Romika (132001), final year, EEE-B

Disaster management (or emergency management) is the creation of plans through which communities reduce vulnerability to hazards and cope with disasters. Disaster management does not avert or eliminate the threats; instead, it focuses on creating plans to decrease the effect of disasters. Failure to create a plan could lead to human mortality, lost revenue, and damage to assets. Currently in the United States 60 percent of businesses do not have emergency management plans. Events covered by disaster management include acts of terrorism, industrial sabotage, fire, natural disasters (such as earthquakes, hurricanes, etc.), public disorder, industrial accidents, and communication failures.

Emergency planning ideals:

If possible, emergency planning should aim to prevent emergencies from occurring, and failing that, should develop a good action plan to mitigate the results and effects of any emergencies. As time goes on, and more data becomes available, usually through the study of emergencies as they occur, a plan should evolve. The development of emergency plans is a cyclical process, common to many risk management disciplines, such as Business Continuity and Security Risk Management, as set out below:

- Recognition or identification of risks
- Ranking or evaluation of risks
- Resourcing controls
- Reaction Planning
- Reporting & monitoring risk performance
- Reviewing the Risk Management framework

There are a number of guidelines and publications regarding Emergency Planning, published by various professional organizations such as ASIS, National Fire Protection Association (NFPA), and the International Association of Emergency Managers (IAEM). There are very few Emergency Management specific standards, and emergency management as a discipline tends to fall under business resilience standards.

In order to avoid, or reduce significant losses to a business, emergency managers should work to identify and anticipate potential risks, hopefully reducing their probability of occurring. In the event that an emergency does occur, managers should have a plan prepared to mitigate the effects of that emergency, as well as to ensure Business Continuity of critical operations post-incident. It is essential for an organization to include procedures for determining whether an emergency situation has occurred and at what point an emergency management plan should be activated.

An emergency plan must be regularly maintained, in a structured and methodical manner, to ensure it is up-to-date in the event of an emergency. Emergency managers generally follow a common process to anticipate, assess, prevent, prepare, respond and recover from an incident.

Pre-incident training and testing:

Emergency management plans and procedures should include the identification of appropriately trained staff members responsible for decision-making when an emergency occurs. Training plans should include internal people, contractors and civil protection partners, and should state the nature and frequency of training and testing.

Testing of a plan's effectiveness should occur regularly. In instances where several business or organizations occupy the same space, joint emergency plans, formally agreed to by all parties, should be put into place.

Communicating and incident assessment:

Communication is one of the key issues during any emergency, pre-planning of communications is critical. Miscommunication can easily result in emergency events escalating unnecessarily.

Once an emergency has been identified a comprehensive assessment evaluating the level of impact and its financial implications should be undertaken. Following assessment, the appropriate plan or response to be activated will depend on specific pre-set criteria within the emergency plan. The steps necessary should be prioritized to ensure critical functions are operational as soon as possible.

Local Emergency Planning Committees:

Local Emergency Planning Committees (LEPCs) are required by the United States Environmental Protection Agency under the Emergency Planning and Community Right-to-Know Act to develop an emergency response plan, review the plan at least annually, and provide information about chemicals in the community to local citizens. This emergency preparedness effort focuses on hazards presented by use and storage of extremely hazardous, hazardous and toxic chemicals. Particular requirements of LEPCs include

- Identification of facilities and transportation routes of extremely hazardous substances
- Description of emergency response procedures, on and off site
- Designation of a community coordinator and facility emergency coordinator(s) to implement the plan
- Outline of emergency notification procedures
- Description of how to determine the probable affected area and population by releases
- Description of local emergency equipment and facilities and the persons responsible for them
- Outline of evacuation plans.

ECONOMICS OF TRANSMISSION AND DISTRIBUTION

M.Shalini (132006), final year, EEE 'C'

INTRODUCTION:

In most industrialized countries, electric power is provided by generating facilities that serve a large number of customers. These generating facilities, known as central station generators, are often located in remote areas, far from the point of consumption. The economics of central station generation is largely a matter of costing. As with any other production technology, central station generation entails fixed and variable costs. The fixed costs are relatively straightforward, but the variable cost of power generation is remarkably complex. We will examine each of these in turn.

DESCRIPTION:

The fixed costs of power generation are essentially capital costs and land. The capital cost of building central station generators vary from region to region, largely as a function of labor costs and "regulatory costs," which include things like obtaining siting permits, environmental approvals, and so on. It is important to realize that building central station generation takes an enormous amount of time. In a state, such as Texas (where building power plants is relatively easy), the time-to-build can be as short as two years. In California, where bringing new energy infrastructure to fruition is much more difficult (due to higher regulatory costs), the time-to-build can exceed ten years. Table 5.1 shows capital cost ranges for several central-station technologies. Although the ranges in Table 5.1 are quite wide, they still mask quite a bit of uncertainty in the final cost of erecting power plants.

Operating costs for power plants include fuel, labor and maintenance costs. Unlike capital costs which are "fixed" (don't vary with the level of output), a plant's total operating cost depends on how much electricity the plant produces. The operating cost required to produce each MWh of electric energy is referred to as the "marginal cost." Fuel costs dominate the total cost of operation for fossil-fired power plants. For renewables, fuel is generally free (perhaps with the exception of biomass power plants in some scenarios); and the fuel costs for nuclear power plants are actually very low. For these types of power plants, labor and maintenance costs dominate total operating costs.

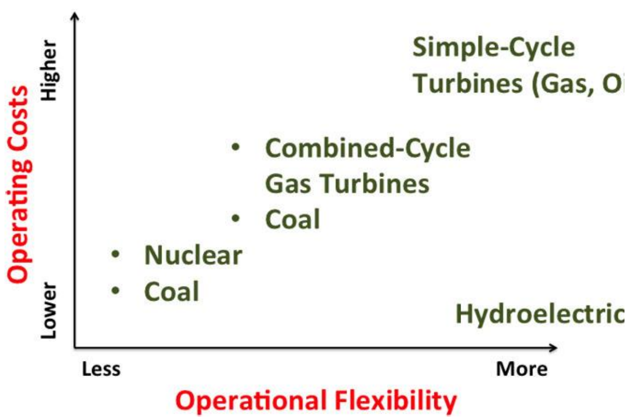
The following characteristics which influence the plant's operations:

- **Ramp rate**
  This variable influences how quickly the plant can increase or decrease power output, in [MW/h] or in [% of capacity per unit time]
- **Ramp time**
  The amount of time it takes from the moment a generator is turned on to the moment it can start providing energy to

the grid at its lower operating limit (see below), in [h]

- **Capacity**
  The maximum output of a plant, in [MW]
- **Lower Operating Limit (LOL)**
  The minimum amount of power a plant can generate once it is turned on, in [MW]
- **Minimum Run Time**
  The shortest amount of time a plant can operate once it is turned on, in [h].
- **No-Load Cost**
  The cost of turning the plant on, but keeping it "spinning," ready to increase power output, in [$/MWh]. Another way of looking at the no-load cost is the fixed cost of operation; i.e., the cost incurred by the generator that is independent of the amount of energy generated.
- **Start-up and Shut-down Costs**
  These are the costs involved in turning the plant on and off, in [$/MWh].

GRAPH:



CONCLUSION:

The minimum run time and ramp times determine how flexible the generation source is; these vary greatly among types of plants and are a function of regulations, type of fuel, and technology. Generally speaking, plants that are less flexible (longer minimum run times and slower ramp times) serve base load energy, while plants that are more flexible (shorter minimum run times and quicker ramp times) are better-suited to filling peak demand. Table 5.2 and Figure 5.3 show approximate (order-of-magnitude) minimum run times and ramp times for several generation technologies. It is important to realize that, in some sense, these are "soft" constraints. It is possible, for example, to run a nuclear plant for five hours and then shut it down. Doing this, however, imposes a large cost in the form of wear and tear on the plant's components.

The cost structure for transmission and distribution is different than for power generation, since there is basically no fuel cost involved with operating transmission and distribution wires (and their associated balance-of-systems, like substations). At the margin, the cost of loading a given transmission line with additional electricity is basically zero (unless the line is operating at its rated capacity limit). Capital cost thus dominates the economics of transmission and distribution.

ECONOMICS OF TRANSMISSION AND DISTRIBUTION IN POWER SYSTEM

A. Vahitha Sulthana (132002), EEE-C, IV YEAR

In most industrialized countries, electric power is provided by generating facilities that serve a large number of customers. These generating facilities, known as central station generators, are often located in remote areas, far from the point of consumption. The economics of central station generation is largely a matter of costing. As with any other production technology, central station generation entails fixed and variable costs. The fixed costs are relatively straightforward, but the variable cost of power generation is remarkably complex. We will examine each of these in turn.

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In general, central station generators face a tradeoff between capital and operating costs. Those types of plants that have higher capital costs tend to have lower operating costs. Further, generators which run on fossil fuels tend to have operating costs that are extremely sensitive to changes in the underlying fuel price. The right-most column of Table 5.1 shows typical ranges for operating costs for various types of power plants. **Note that these costs do not include subsidies, incentives, or any "social costs" (e.g., air or water emissions)**

Because of the apparent tradeoff between capital and operating cost, comparing the overall costs of different power plant technologies is not always straightforward. Often times, you will see power plants compared using a measure called the "Levelized Cost of Energy" (LCOE), which is the average price per unit of output needed for the plant to break even over its operating lifetime. We will discuss LCOE in more detail in a future lesson - it is an extremely important (and often-used) cost metric for power plants, but it has its own problems that you will need to keep in the back of your head.

Irrespective of technology, all generators share the following characteristics which influence the plant's operations:

- **Ramp rate**
  This variable influences how quickly the plant can increase or decrease power output, in [MW/h] or in [% of capacity per unit time]
- **Ramp time**
  The amount of time it takes from the moment a generator is turned on to the moment it can start providing energy to the grid at its lower operating limit (see below), in [h]
- **Capacity**
  The maximum output of a plant, in [MW]
- **Lower Operating Limit (LOL)**
  The minimum amount of power a plant can generate once it is turned on, in [MW]
- **Minimum Run Time**
  The shortest amount of time a plant can operate once it is turned on, in [h].
- **No-Load Cost**
  The cost of turning the plant on, but keeping it "spinning," ready to increase power output, in [$/MWh]. Another way of looking at the no-load cost is the fixed cost of operation; i.e., the cost incurred by the generator that is independent of the amount of energy generated.
- **Start-up and Shut-down Costs**
  these are the costs involved in turning the plant on and off, in [$/MWh]. The minimum run time and ramp times determine how flexible the generation source is; these vary greatly among types of plants and are a function of regulations, type of fuel, and technology. Generally speaking, plants that are less flexible (longer minimum run times and slower ramp times) serve base load energy, while plants that are more flexible (shorter minimum run times and quicker ramp times) are better-suited to filling peak demand. Table 5.2 and Figure 5.3 show approximate (order-of-magnitude) minimum run times and ramp times for several generation technologies. It is important to realize that, in some sense, these are "soft" constraints. It is possible, for example, to run a nuclear plant for five hours and then shut it down. Doing this, however, imposes a large cost in the form of wear and tear on the plant's components.

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ENERGY EFFICIENT LAMP

M.Yokesh (132308), EEE-IV-C

Electric lighting burns up to 25% of the average home energy budget.

The electricity used over the lifetime of a single incandescent bulb costs 5 to 10 times the original purchase price of the bulb itself.

Light Emitting Diode (LED) and Compact Fluorescent Lights (CFL) bulbs have revolutionized energy-efficient lighting.

CFLs are simply miniature versions of full-sized fluorescents. They screw into standard lamp sockets, and give off light that looks similar to the common incandescent bulbs - not like the fluorescent lighting we associate with factories and schools.

LEDs are small, very efficient solid bulbs. New LED bulbs are grouped in clusters with diffuser lenses which have broadened the applications for LED use in the home. LED technology is advancing rapidly, with many new bulb styles available. Initially more expensive than CFLs, LEDs bring more value since they last longer. Also, the price of LED bulbs is going down each year as the manufacturing technology continues to improve.

LED Lighting:

LEDs (Light Emitting Diodes) are solid light bulbs which are extremely energy-efficient. When first developed, LEDs were limited to single-bulb use in applications such as instrument panels, electronics, pen lights and, more recently, strings of indoor and outdoor Christmas lights.

Manufacturers have expanded the application of LEDs by "clustering" the small bulbs. The first clustered bulbs were used for battery powered items such as flashlights and headlamps. Today, LED bulbs are made using as many as 180 bulbs per cluster, and encased in diffuser lenses which spread the light in wider beams. Now available with standard bases which fit common household light fixtures, LEDs are the next generation in home lighting.

A significant feature of LEDs is that the light is directional, as opposed to incandescent bulbs which spread the light more spherically. This is an advantage with recessed lighting or under-cabinet lighting, but it is a disadvantage for table lamps. New LED bulb designs address the directional limitation by using diffuser lenses and reflectors to disperse the light more like an incandescent bulb.

The high cost of producing LEDs has been a roadblock to widespread use. However, researchers at Purdue University have developed a process for using inexpensive silicon wafers to replace the expensive sapphire-based technology. This promises to bring LEDs into competitive pricing with CFLs and incandescent. LEDs may soon become the standard for most lighting needs. We are following these developments with interest and will report the latest updates in this research.

Benefits of LED Light bulbs:

Long-lasting - LED bulbs last up to 10 times as long as compact fluorescents, and far longer than typical incandescent.

Durable - since LEDs do not have a filament, they are not damaged under circumstances when a regular incandescent bulb would be broken. Because they are solid, LED bulbs hold up well to jarring and bumping.

Cool - these bulbs do not cause heat build-up; LEDs produce 3.4 but's/hour, compared to 85 for incandescent bulbs. Common incandescent bulbs get hot and contribute to heat build-up in a room. LEDs prevent this heat build-up, thereby helping to reduce air conditioning costs in the home.

Mercury-free - no mercury is used in the manufacturing of LEDs.

More efficient - LED light bulbs use only 2-17 watts of electricity (1/3rd to 1/30th of Incandescent or CFL). LED bulbs used in fixtures inside the home save electricity, remain cool and save money on replacement costs since LED bulbs last so long. Small LED flashlight bulbs will extend battery life 10 to 15 times longer than with incandescent bulbs.

Cost-effective - although LEDs are initially expensive, the cost is recouped over time and in battery savings. LED bulb use was first adopted commercially, where maintenance and replacement costs are expensive. But the cost of new LED bulbs has gone down considerably in the last few years. And are continuing to go down. Today, there are many new LED light bulbs for use in the home, and the cost is becoming less of an issue. To see a cost comparison between the different types of energy-saving light bulbs, see our Light Bulb Comparison Charts.

Light for remote areas and portable generators - because of the low power requirement for LEDs, using solar panels becomes more practical and less expensive than running an electric line or using a generator for lighting in remote or off-grid areas. LED light bulbs are also ideal for use with small portable generators which homeowners use for backup power in emergencies.

Choosing an LED Light bulb:

Many different models and styles of LED bulbs are emerging in today's marketplace. When choosing a bulb, keep in mind the following:

• Estimate desired brightness - read the package to choose desired brightness level.

You can use wattage to compare bulb illumination, for example, a 9W LED is equivalent in output to a 45 W incandescent. However, the new method for comparing bulbs is lumens. Lumens are the measure of perceived brightness, and the higher the lumens, the brighter the bulb. The FTC has mandated that all light bulb packages display lumens as the primary measure for comparing bulbs. For more information about lumens, see LED Terminology further down this page.

• Do you need a 3-Way bulb? - New LED bulbs are available as combination 3-Way bulbs. These replace 30, 60 and 75-watt incandescent bulbs, while consuming 80% less power than an incandescent bulb! The Switch 3-Way LED is also omnidirectional, so it can be used anywhere you would use an incandescent.

• Choose between warm and cool light - new LED bulbs are available in 'cool' white light, which is ideal for task lighting, and 'warm' light commonly used for accent or small area lighting.

• Standard base or pin base - LEDs are available in several types of 'pin' sockets or the standard "screw' (Edison) bases for recessed or track lighting.

• Choose between standard and dimmable bulbs - some LED bulbs, such as the Switch, LED novation and FEIT LED bulbs, are now available as dimmable bulbs. They will work on your standard dimmer switch.

• Choose high quality bulbs or they will die prematurely - do not buy cheap bulbs from eBay or discounters. They are inexpensive because the bulbs use a low-quality chip which fails easily.

• Look for certifications - including FCC, Energy Star and UL.

LED Bulb Colors:

Most LED bulbs in use today are clear or white bulbs, commonly available in 'cool' or 'warm' white light. But LEDs are also available in colors and used as individual bulbs, or in clusters, for special applications.

Red - Red is the traditional color for maintaining night vision. Some LED headlamps and flashlights have the option of switching to red light for use at night.

Green - Green is now the preferred color for pilots and the military. The green color is also great for retaining night vision, and it doesn't erase, or render invisible, the red markings on maps and charts.

Blue - Many people like the blue because it is very easy on the eyes. Blue appears to be a good reading light for elderly eyes. Elderly folks report that they can read under the blue light for hours without eyestrain, compared to severe eyestrain in less than 30 minutes with incandescent lighting.

White - The most popular of the LED colors. It produces a soft white light, without harsh reflection, glare or shadows.

Amber - LED amber bulbs do not attract flying insects, as do ordinary white bulbs. Amber LEDs are used outdoors in areas such as patios and decks where insects flying around lights are a nuisance.

Comparing LED vs CFL vs Incandescent Wattage

To compare different light bulbs, you need to know about lumens. Lumens, not watts, tell you how bright a light bulb is, no matter the type of bulb. The more lumens, the brighter the light. Beginning in 2012, labels on the front of light bulb packages now state a bulb's brightness in lumens, instead of the bulb's energy usage in watts. For more information, read our article Lumens are the new watts.

While lumens are the best measurement of comparative lighting among the various bulbs, it is not always a perfect measure. Some floodlights in can lighting use an internal reflector in the bulb to send the light facing downward. When shopping for light bulbs, note that bulbs equipped with reflectors will deliver increased directional light.

The chart below shows the amount of brightness in lumens you can expect from different wattage light bulbs. The LED bulbs require much less wattage than the CFL or Incandescent light bulbs, which is why LED bulbs are more energy-efficient and long lasting than the other types of bulb.

ENERGY EFFICIENT LAMP AND ITS APPLICATIONS

MADUMITHA.C (142016), 3rd YEAR, EEE-B

Electric lighting is a major energy consumer. Enormous energy savings are possible using energy efficient equipment, effective controls, and careful design. Using less electric lighting reduces heat gain, thus saving air-conditioning energy and improving thermal comfort. Electric lighting design also strongly affects visual performance and visual comfort by aiming to maintain adequate and appropriate illumination while controlling reflection and glare. Lighting is not just a high priority when considering hotel design; it is also a high return, low-risk investment. By installing new lighting technologies, hotels can reduce the amount of electricity consumed and energy costs associated with lighting. There are several types of energy efficient lighting and affordable lighting technology. The following are a few examples of energy-saving opportunities with efficient lighting.

Installation of Compact Fluorescent Lamps (CFLs) In Place of Incandescent Lamps.

Compact Fluorescent Lamps use a different, more advanced technology than incandescent light bulbs and come in a range of styles and sizes based on brand and purpose. They can replace regular, incandescent bulbs in almost any light fixture including globe lamps for the bathroom vanity, lamps for recessed lighting, dimming, and 3-way functionality

lights. CFLs use about 2/3 less energy than standard incandescent bulbs, give the same amount of light, and can last 6 to 10 times longer. CFL prices range from $4 to $15 depending on the bulb, but you save about $25 to $30 per bulb on energy during the lifetime of the bulb. Energy Efficient Lighting Electric lighting is a major energy consumer. Enormous energy savings are possible using energy efficient equipment, effective controls, and careful design. Using less electric lighting reduces heat gain, thus saving air-conditioning energy and improving thermal comfort. Electric lighting design also strongly affects visual performance and visual comfort by aiming to maintain adequate and appropriate illumination while controlling reflection and glare. Lighting is not just a high priority when considering hotel design; it is also a high return, low-risk investment. By installing new lighting technologies, hotels can reduce the amount of electricity consumed and energy costs associated with lighting. There are several types of energy efficient lighting and affordable lighting technology. The following are a few examples of energy-saving opportunities with efficient lighting. When looking to purchase CFLs in place of incandescent bulbs, compare the light output, or Lumens, and not the watts. Watts refers to the amount of energy used, not the amount of light. In other words, if the incandescent bulb you wish to replace is 60 Watts, this is equal to 800 Lumens. To get the same amount of light in a CFL, you should look to find a CFL that provides 800 Lumens or more (equal to about a 13-watt fluorescent bulb). Use the table below to easily figure the conversions**.**

Installation of Energy-Efficient Fluorescent Lamps in Place Of "Conventional" Fluorescent Lamps.

Many lodging facilities may already use fluorescent lighting in their high traffic areas such as the lobby or office area. However, not all fluorescent lamps are energy efficient and cost effective. There are several types of fluorescent lamps that vary depending on the duration of their lamp life, energy efficiency, regulated power, and the quality of color it transmits. There are a few styles worth noting; these models are simply labeled as "T-12", "T-8", or "T-5". The names come from the size of their diameter per eighth inch. For example, a T-12 lamp is 12/8 inch in diameter (or 1 1/2 inch); a T-8 lamp is 8/8 inch in diameter (or 1 inch); a T-5 lamp is 5/8 inch in diameter. This is a simple way to identify the type of fluorescent lamps your facility is using. The recommended style of fluorescent lighting is a T-8. T-8 lights are the most cost effective. They usually cost about $0.99 a bulb and are 30% to 40% more efficient than standard T-12 fluorescent lamps, which have poor color rendition and cause eye strain. T-8 lamps provide more illumination, better color, and don't flicker (often exhibited by standard fluorescent fixtures). T-5 lamps are the most energy efficient and also tend to transmit the best color; however, they usually cost about $5.00 per bulb. Each style of fluorescent lamp cannot function without a ballast. A ballast is an electrical device used in fluorescent lamps to regulate starting and operating characteristics of the lamp. Some ballasts are magnetic where as others are electronic. Electronic high frequency ballasts are now standard for most fluorescent lights. Due to the differences in wattage between the types of lights, if converting from a T-12 to a T-8 light, one must also change the type of ballast being used.

Installation of Occupancy/Motion Sensors to Turn Lights on And Off Where Appropriate

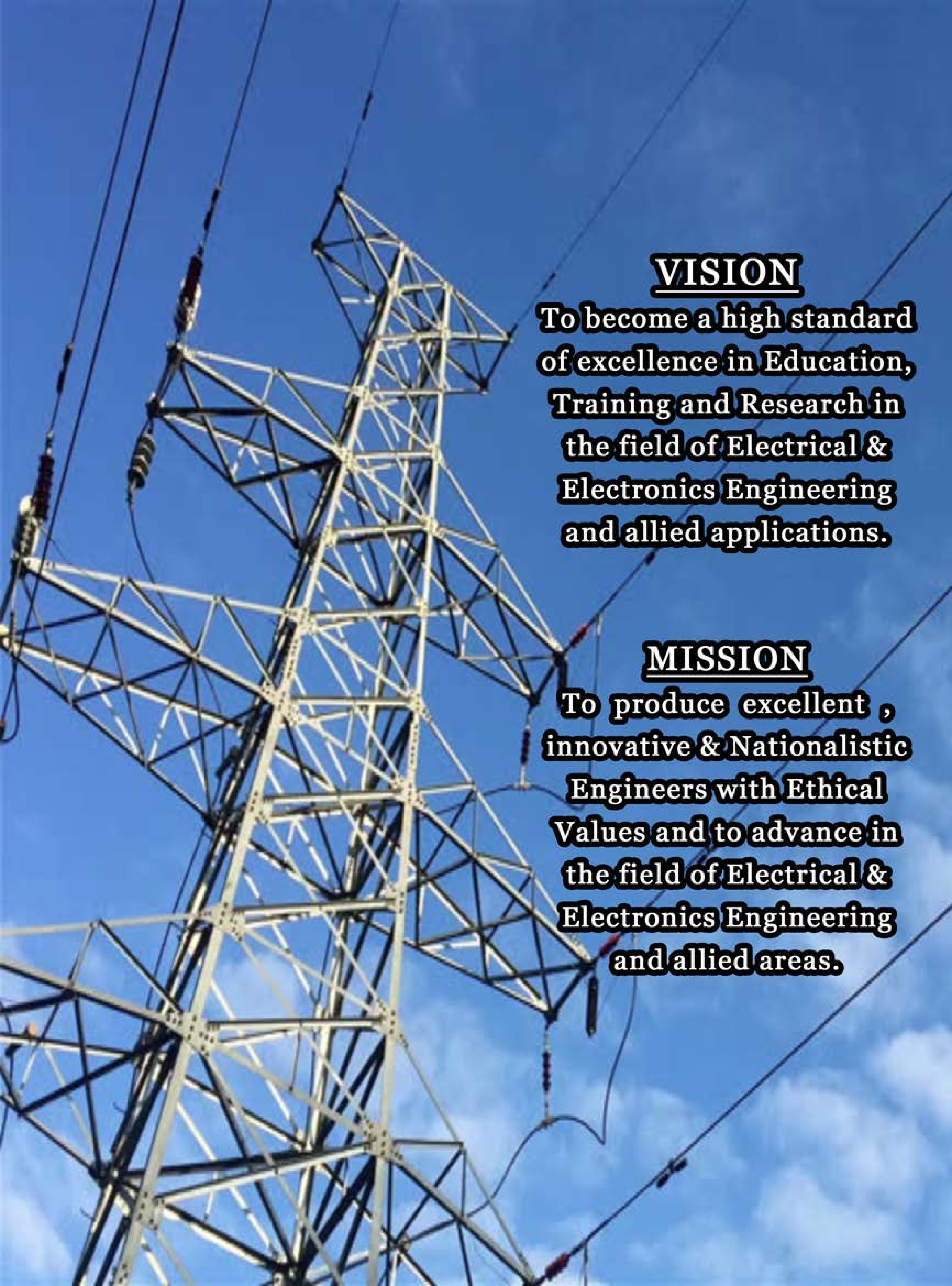
Lighting can be controlled by occupancy sensors to allow operation whenever someone is within the area being scanned. When motion can no longer be detected, the lights shut off. Passive infrared sensors react to changes in heat, such as the pattern created by a moving person. The control must have an unobstructed view of the building area being scanned. Doors, partitions, stairways, etc. will block motion detection and reduce its effectiveness. The best applications for passive infrared occupancy sensors are open spaces with a clear view of the area being scanned. Ultrasonic sensors transmit sound above the range of human hearing and monitor the time it takes for the sound waves to return. A break in the pattern caused by any motion in the area triggers the control. Ultrasonic sensors can see around obstructions and are best for areas with cabinets and shelving, restrooms, and open areas requiring 360-degree coverage. Some occupancy sensors utilize both passive infrared and ultrasonic technology, but are usually more expensive. They can be used to control one lamp, one fixture or many fixtures. The table below provides typical savings achievable for specific building areas, as determined by EPA studies, with the average savings being 60%.

Use an Automated Device, Such as A Key Tag System, To Regulate the Electric Power in A Room.

The key tag system uses a master switch at the entrance of each guest room, requiring the use of a room key-card to activate them. Using this technique, only occupied rooms consume energy because most electrical appliances are switched off when the keycard is removed (when the guest leaves the room). Along with lighting, the heating, air conditioning, radio and television may also be connected to the master switch. This innovation has a potential savings of about $105.00 per room per year.

Offer Nightlights to Prevent the Bathroom Lights from Being Left on All Night.

Many guests opt to have a light on while they sleep. By turning the bathroom light on and leaving the bathroom door cracked open, guests are able to find their way through an unknown room in the middle of the night. Those who are accompanied by children may often do the same to comfort their child. By offering a nightlight, the energy used to power a bathroom light during the nighttime can be avoided and guests will still be able to feel comfortable in unfamiliar territory. One particular model uses six Light Emitting Diodes (LEDs) in the panel of a light switch to provide light for guests. LEDs are just tiny light bulbs that fit easily into an electrical circuit. They are different from ordinary incandescent bulbs because they don’t burn out or get really hot. They are often used in digital clocks or remote controls.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