Course on Basics of Energy Efficient Lighting Systems
February 13-14, Kolkata

The School of Illumination Science Engineering and Design (SISED), Jadavpur University and ISLE organised a two day Lighting Course at Jadavpur University in February.

Targeted at Architects, Consultants, Project Managers and Engineers, Interior Designers, Lighting Practitioners, Builders and Developers, Traders, Contractors, University Teachers and Students, the course consisted of both theoretical classes at the KP Basu Memorial Hall as well as practical demonstrations at the Illumination Engineering Laboratory at Jadavpur University. After the theoretical classes on February 14, a test was given to the course participants.

The course attracted a total of 55 participants. The course fee was Rs. 500 for Students, Rs. 1500 for ISLE Members and Rs. 2000 for non Members.

The programme is given below.

13th February 2009

Coffee sponsored by Binay Opto Electronics Ltd

Inaugural Session

Theoretical Classes
Lighting Fundamentals by Prof. K. Goswami, JU
Light Sources & Luminaires by A. Mukherjee, CSET
Lighting Control Gear by Dr. S. Mazumdar, JU

Lunch sponsored by Bajaj Electricals

Theoretical Classes
Indoor Lighting by Suddhasatwa Chakraborty, JU
Application of Energy Efficient Lighting by K Naveen, Bajaj Electricals Ltd
Lighting System Management by Sisir Ganguly – Former Chief Engineer, PWD

Tea

Practical Classes
Laboratory on Lighting and Electrical Measuring Instruments/Demonstration of Lamp and Luminaire Circuits

14TH FEB'09

Theoretical Classes
Outdoor Lighting by Dr. Biswanath Roy, JU
Energy & Lighting Economics by Mrs. Kamalika Ghosh, JU
Lighting Project Engineering by Onkar Mitra, Consultant

Test

Lunch Sponsored by WBREDA

Practical Classes
Laboratory on Photometry
Valedictory Session
High Tea sponsored by Marc Signage

The course received support from the industry through sponsorships. The lunches were sponsored by Bajaj Electricals and WBREDA, the first coffee break by Binay Opto Electronics and the closing high tea by Marc Signage.

Prof. Goswami covered the first principles of the Radiation laws (Planck, Wien and Stefan-Boltzmann laws), characteristic temperatures and wavelengths for different spectral domains, photometric units and their terminologies, human eye sensitivity, luminous efficacy and efficiency.

Mr. Mukherjee gave an overview of light sources covering the different incandescent lamps, discharge lamps as well as solid state light sources. His presentation of luminaires covered luminaire classification, luminaire functions, safety and light control and IP classifications.

Prof. Mazumdar's presentation on Lighting Control Gears gave a comprehensive look at this important area covering the following components: starting and over current protection, power quality improvement, light level control, light sensing and control and on/off control.

Mr. Chakraborty's coverage of indoor lighting examined the main lighting design criteria for indoor lighting design. This included Illuminance, uniformity of lighting levels, shadow and modeling, colour appearance, colour rendition and coefficient of utilization.

Mr. Ganguly detailed the importance of a conscious culture of maintenance management for a cost effective lighting system covering the issues of basic requirements, schedule planning, checking of specifications and safety aspects.

Dr. Roy, in the first part of his presentation covered the photometric specifications for indoor, road lighting and flood lighting luminaries through graphical methods. The second part focused on the design approach to road lighting and industrial area lighting including design objectives and parameters, selection of lamp and luminaires and pole layout, manual computation of average illuminance and point specific illuminance.

Mrs. Ghosh's presentation on energy and lighting economics covered the impact of energy production both on the Human Development Index as well as on the environment. Highlighting the need for growing awareness she explained terms such as carbon credit, carbon tax, green building concepts, ECBC codes, utilization of daylight and areas for further study and adoption.

Mr. Mitra first discussed issues of professional project management such as site survey, planning, design, specification, execution, finishing and maintenance. The engineering part covered technical aspects and phenomena such as lighting transformer, prospective fault levels, voltage fluctuations, lighting loads, harmonics, condition monitoring, power factor correction, line drop and line loss, surge protection, energy conservation and environment protection.

The abstracts of the presentations are given below.

LIGHTING FUNDAMENTALS

Prof. Kushalendu Goswami, Department of Physics, Jadavpur University

The Lighting fundamentals is discussed from the first principles of the Radiation laws viz. Planck, Wien and Stefan-Boltzmann laws. The characteristic temperatures and characteristic wavelengths are shown for different spectral domains. The photometric units and their terminologies are thoroughly discussed with suitable examples. The human eye sensitivity and photometric quantities are addressed graphically to provide an optimization of variance on environment. Luminous efficacy and luminous efficiency are discussed with numerical examples.

LIGHT SOURCES

Aniruddha Mukherjee, Assistant Professor, Camellia School of Engineering & Technology

The class of light sources which are predominately used are referred as electric light sources. The electric light sources are broadly classified as – incandescent, gas discharge lamps and solid state light. Incandescent lamps are so far the most primitive forms of electric sources. Technically termed as general lighting service, it is based on the fact that by passing an electric current through a wire it can be made to incandescence. Gas discharge lamps unlike solid conductors are non-conducting but electrical insulators. Hence under the influence of an electric field transport of charge carriers can take place and electromagnetic radiation emitted. Another type of low pressure discharge lamp is referred as low pressure sodium vapour lamps also referred to as sodium oxide lamps. In the discharge tube there is an excess of sodium and a mixture of rare gases. Amongst all the discharge none could match the extremely high colour

rendering or emission of “true light”. This fact was achieved in the metal halide variety where improvement in the colour was achieved with the addition of metal halides. The addition of metal halides brought in a drastic change in the pattern of the radiation emitted – practically with the addition the lamp emitted radiation of all the wavelengths in the visible spectrum. The metals were selected to be thallium, sodium and indium and mixed with halogens or halides such as iodine or bromine. With this incorporation of metal halides the quality of radiation emitted was improved considerably. Light emitting diodes are essentially a pn junction semiconductor diode which emits light when operated in a forward direction. Aluminum indium gallium phosphate and indium gallium nitride are the two most common led technologies.

LIGHTING CONTROL GEAR

Dr. Saswati Mazumdar, Director SISED, Jadavpur University

The Control of light on the basis of need plays a very vital role in saving Energy as lighting load consumes a major portion of energy. In this context Lighting Control Gears are very important.

These components can be classified as follows:-

Starting & Over current Protection component:-

The main components are Starter, Ballast, Ignitor. These components can be Magnetic/Electronic, out of which Electronic Ballast can be Dimmable/Non Dimmable

Power Quality Improvement Component:-

In this part voltage supported Spike, RF Suppression filter and Power factor improvement capacitor are the main components.

Light level Control Components:-

These are mainly of two types - Non electronic dimmers and electronic dimmers. Examples – (Mechanical shutters, Reactor dimmers etc. (Thyristor dimmers, Triac dimmers).

Light sensing & Control Components:-

The main component is divided into two categories-

(a) Occupancy sensor, Light level sensor

(b)RGB Controller

ON/OFF Control components:-

This can be classified into Manual Switches and Automatic Switches. Automatic Switches are of again two types Electromagnetic and Electronic.

The types and functions of Ballasts of low pressure & high pressure lamps were described in detail. The features of electronic ballasts, its dimming (including remote controlled dimmers) are discussed with suitable figures. The digitally accessible interfaces of the controller are explained in brief. The necessity of driver circuits of LEDs to control the rated constant current is also described in short.

INTERIOR LIGHTING

Suddhasatwa Chakraborty, Lecturer, Electrical Engineering Department, Jadavpur University

Interior Lighting Design means a lighting design which must confirm the basic requirements of the lighting in any interior space. The interior Lighting Design should have some design criteria. The main lighting design criteria are Lighting Level (Illuminance), Uniformity of Lighting Level, Luminance distribution (in cd/m^2), shadow and modelling, colour appearance and colour rendition. The Interior Lighting design is not only the good quantity of light but must ensure good quality of lighting too. The quality aspects of interior lighting can be achieved by harmonious luminance distribution, application of lights and shadow, restriction of the glare. There are several international and national recommendations available for the above mentioned lighting design parameters.

The proper balance between the quality and quantity parameters can be achieved by general lighting & localized lighting concept.

The Coefficient of Utilization (COU) is a very important aspect in Interior Lighting. The COU indicates the approximate numbers of Luminaires required for a specified office Interior. The Zonal Cavity Method is the best method to find out the COU value for a specific Luminaire. Once the room dimensions are known, the entire room can be segregated as combination of three cavities like Ceiling Cavity, Room Cavity and Floor Cavity. The COU table will help the designer to get the appropriate COU values for the interior.

The other important factor in lighting design is the proper spacing of the Luminaires. The thumb rule states that, the distance between the two consecutive luminaires should be 3 times of the distance between the side Luminaire and the wall. Different lighting design software is available which will calculate the spacing also. The energy consuming tools which can enrich the interior lighting design must consider the controllability aspects of lighting along with daylight integration.

The ultimate successful interior lighting must confirm the concept that, the Lighting for People not for void space, but in the proper way.

FUNDAMENTALS OF LIGHTING SYSTEM MAINTENANCE MANAGEMENT

S. K. Gangopadhyay, Fellow ISLE

Importance and Objectives

A lighting installation, however well built cannot remain so, for long, unless and until the same is maintained well. The main objective of maintenance management is to get the same performance / service from the lighting system in a cost effective way during its life - cycle.

Different Types of Maintenance Work

(a). Planned Maintenance i.e. Preventive Maintenance (b) Corrective Maintenance and (c) Non-planned Maintenance arising out of emergency situations.

Basic Requirements

a)Team of Workers, (b) Statutory Requirement of Persons viz. qualification, experience, authorization, competence etc as per extant rules. (c) Supporting tools & plants, instruments, appliances and accessories for work.

Well Planned Maintenance Schedule indicating things to he done daily, weekly, fortnightly, monthly etc. There should be clear work schedule with clear objectives.

Usual Items of Maintenance

Visual inspection, cleaning, relamping, checking, testing and replacing lighting accessories. As the calculation of the lighting design involves Maintenance Factor etc so well planned maintenance schedule must be adhered to.

Dirt is the enemy of illumination. So cleaning of lamps and luminaires as per definite schedule is to be done meticulously.

Checking Specifications of replacements like lamp and accessories is rather important, else there can be problems of mismatching and poor result.

Safety Aspects must be given due importance and to be ensured by all means and particularly by observing relevant rules and codes etc.

Energy Conservation in the lighting system including its maintenance is really on the agenda now and also includes its cost-effectiveness and as such to be given utmost importance. Good maintenance should not only try to hold the designed illumination parameters but also take steps to upgrade the existing lighting system to make it more energy-efficient.

A conscious maintenance culture is very much needed.

OUTDOOR LIGHTING

Dr. Biswanath.Roy, Reader, Illumination Engg,. Electrical Engg. Dept., J.U.

Photometric parameter of a luminaire is one of the luminaire selection tools for different lighting applications. The first part of the lecture deals with photometric specifications of indoor, road and floodlight luminaires. Two graphical methods – Polar intensity plot and Iso-candela diagram, are discussed with illustrations. How these graphical representations of luminous intensity distribution are studied in practice while selecting a luminaire is also discussed.

The second part of the lecture is on design approach to outdoor lighting. In this part, only Roadlighting and Industrial Area lighting were covered.

The followings were discussed under roadlighting -

- Design objectives
- Design parameters according to IS:1944
- Selection of Pole layout
- Pole installation geometry
- Lamp & Luminaire selection
- Manual computation of average illuminance using COU diagram and point-specific illuminance Isolux contour,

And the following topics were dealt with under Industrial Area lighting -

- Design objectives
- Design parameters according to IS:6665
- Selection of Pole, Semi high-mast, high-mast
- Lamp & luminaire selection
- Estimation of quantity of luminaire for desired average illumination.

Moreover, effect of pole layout and luminaire mounting on design parameters in case of above two lighting applications were demonstrated with the help of few design outputs of lighting design software.

ENERGY AND LIGHTING ECONOMICS

Kamalika Ghosh, Lecturer, Dept. of Electrical Engineering, Jadavpur University

In this lecture the author describes the various aspects of lighting and required energy from economy point of view. Since India is a developing country and trying to be close to developed countries. The draw back for economical development of India is its poverty. After food, energy is the prime tool for development of a country. Electrical energy has been popular due to easy of operations. Since a significant amount of eletrical energy (about 17 - 20%) in India goes for lighting we need to be economize for the same.

In this lesson various fundamental terms of economics was initially explained. It has also explain how complete economic development of a country can be possible both in micro as well as macro level, e.g., if we do not upgrade the life expectancy, literacy, educational attainment of a country, i.e., human development index of poor villagers also the economic development of the country as a whole can not be possible .

If we can provide cost effective light and electrical energy resource to them the poor can study properly even after their daily work, they can earn more even when the daylight is absent. Doctors and good quality of medicines (which need refrigeration) will be available in villages.

Apart from conventional sources of energy various unconventional energy resources may be availed The limitation of use of conventional energy for rural electrification, e.g., poor pricing, poor load factor, distance from grid connectivity, wide distributed load with small demand etc. is explained.

Various advantages of distributed generation, e.g., most of dg technologies are without any environmental impacts: pollution reduction, dg units are closer to users: less t & d losses, easier to find sites for smaller generators, shorter installation times, investment risk is low, increased power quality and grid security are explained and more emphasis is given for use of non conventional energy.

Various crucial terms, e.g., global warming, carbon credit, carbon tax, green building concept, ECBC codes, utilization of daylight along with various technical points for its proper utilization etc. are described for development of awareness among people.

The technology behind the proper selection of lamp as well as controlling devices, e.g. Occupancy sensors are described as an energy saving tool. Various points for energy auditing and management are explained .

Areas for further studies and adoption e.g. Proper development of laminar with suitable profile for use of LED, development of BIPV system and coupled with LED, proper utilization of building infra red generation for lighting purpose, proper utilization solar panel as building material and building orientation, etc is proposed .

LIGHTING PROJECT ENGINEERING AND MANGEMENT

Onkar Mitra, Consultant

The Speaker took up the Management part first. He discussed various points of a Professional Project Management, e.g. Site Survey, Planning, Design, Specification, Bill of Materials, Tools & Tackles, Estimating the Project, Finance, Site Readiness, Actual Execution, Finishing Stage and Periodic Maintenance.

Then, in the Engineering part, the speaker mentioned and discussed different Technical items, aspects and phenomena like Lighting Transformer, Prospective Fault Level, Voltage Fluctuations, Lighting Load Main Cable, Harmonics Problem and its Solution using special Transformers & Filters, Condition Monitoring, Caution with Neutral, Power Factor Correction to minimize associated Line Drop & Line Loss, Surge Protection, Energy Conservation & Environment Protection.

Speaker also mentioned the National Building Code – 2005, National Lighting Code – 2008 and Energy Conservation Building Code – 2006**,** for reference and guidance in order to execute a Lighting Project successfully.