

# Report of Green, Environment and Energy Audits as per the ISO/IEC 17020:2012 Standards



*Submitted to*

**MEA ENGINEERING COLLEGE  
PERINTHALMANNA, MALLAPURAM - 679 325  
KERALA, INDIA**

*Date of Audit: 20.11.2023*



Regd. No. 114 / 2017



*Submitted by*

**NATURE SCIENCE FOUNDATION**

**[A Unique Research and Development Centre for Society Improvement]**

**No. 2669, LIG-II, Gandhi Managar, Peelamedu**

**Coimbatore 641 004, Tamil Nadu, India**

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# NATURE SCIENCE FOUNDATION

(A Unique Research and Development Centre for Society Improvement)  
ISO 9001:2015, 14001:2015, 45001:2018 & 50001:2018 Certified and Ministry of MSME Registered Organization  
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Dr. S. RAJALAKSHMI, M.B.A., Ph.D., FNSF.,  
Chairman

Mr. P. KANAGARAJ, FNSF.,  
Secretary

## Certificate of Declaration

The **Office of Nature Science Foundation**, Coimbatore, Tamil Nadu declare that

1. Nature Science Foundation has conducted onsite green audit at **MEA Engineering College, Perinthalmanna, Mallapuram – 679 325, Kerla, India** by deputing certified Lead Auditors and Technical Experts.
2. On the basis of audit observations by the auditors and pertinent data collected from the Auditee, the Technical Report has been prepared and being submitted.
3. Data presented in the Technical Report are verified and to best of our knowledge, the data are authentic and reliable.
4. Nature Science Foundation declares that data generated were not shared with any third parties and the soft copy of the report is available with Nature Science Foundation's Office till its validity.
5. Provided the Auditee desired to publish or share the data with other agencies, Nature Science Foundation has no conflict of interest.
6. We at Nature Science Foundation express our deep sense of gratitude to the Management for given an opportunity to conduct green audit at their premises in compliance with NAAC criteria in line with ISO/IEC 17020:2012 standards and NABCB guidelines and for whole hearted support extended at the time of onsite audit. Our sincere thanks to NAAC, IQAC Coordinators and Head of the Departments of the Organization for their intangible assistance and cooperation extended to the audit team at the time of physical facility verification.

  
Dr. P.V. Sreenivasan, M.Sc., M.Phil., Ph.D.,  
Director  
NATURE SCIENCE FOUNDATION  
LIG-II, 2669, Gandhi Managar  
Peelamedu, Coimbatore - 641 004  
Tamil Nadu, India.

Date: 20.11.2023  
Place: Coimbatore

Authorized Signatory  
Nature Science Foundation

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# 1. GENERAL INTRODUCTION

## 1.1. Introduction

Green campus is an area of the Organization or the Organization as a whole itself contributing to have an infrastructure or development that is structured/planned to incur less energy, less water, less or no CO<sub>2</sub> emission and less or pollution free environment. Green Audit is a tool to evaluate environment management system which is systematically executed to protect and preserve the environment. Green audit constitutes the environmental friendly practices and education combined to promote sustenance of green environment by adopting user-friendly technology within the campus. It creates awareness on environmental ethics, resolves environmental issues and offers solutions to various social and economic needs (APHA, 2017). It strengthens the concept of 'Green Building' and 'Oxygenated Building' which in turn provides a healthy atmosphere to the stakeholders.

## 1.2. Importance of National Building Code (NBC)

National Building Code (NBC) of India has a set of rules and guidelines that regulates construction of buildings and as well as ecofriendly activities of the campus without harming the environment. In order to achieve the minimum standards of welfare and safety of stakeholders of a campus, the Governing body of Central and State Governments lays down a set of guidelines to offer sustainable environment. In 1970, the National Building Code (NBC) was first published in India and the significant provisions of the Indian Building Code involve: 1. Structural safety of the building, 2. Earthquake-resistant building design, 3. Fire and life safety, 4. Solid waste management, 5. Accessibility for differently-abled and senior citizens, 6. Use of alternative building techniques and 7. Environmentally compatible building construction techniques like the use of solar power, rainwater harvesting, etc.

NBC is not only offer a standard uniform benchmark that constructors and environmentalists must meet, but they also establish safety standards along with ecofriendly atmosphere of a campus for years to come. As extreme weather conditions and fires are growing rapidly in the country, it becomes vital that buildings and structures be built and designed using the current building codes to allow for maximum safety sustainability and resilience to the stakeholders. For instance, new and updated building codes put much emphasis on conservation as energy and the degradable and non-degradable wastes are the most expensive byproduct of older regions. This will not only offer environmental benefits to future generations but will also regulate indoor air pollution and greenhouse gas emissions to protect the health of human beings.

Before the introduction of NBC in the construction industry, building commercial and residential properties used a lot of energy which adversely affected the sustainable environment. Thus, enforcing building codes to create low-energy buildings offers a tangible way for the company to help decrease the greenhouse gas emissions of the nation. While safety is the primary objective, new building codes are making significant contributions toward solving energy issues relating to the use of

environmentally compatible construction techniques like planting trees, landscaping, rainwater harvesting and renewable and non-renewable energy sources.

### **1.3. Role of Educational Institutions in natural resource conservation**

In view of providing eco-friendly atmosphere to the stakeholders, educational institutions are focused on establishing and maintenance of green and eco-friendly campus without harming the environment. A clean and healthy surrounding in an organization determine the effective learning/teaching and provides a favorable learning environment to the students. Educational institutions are insisted by both Central and State Governments to provide green, healthier and eco-friendly atmosphere to the stakeholders. Implementation of Swachh Bharath Abhiyan Scheme by the Indian Government through Educational Institutions imparted neat and clean environment at tribal, rural and urban areas across the country. Seminar, Conference, Workshop, training and awareness programmes on biodiversity conservation education, environmental awareness programmes, etc., may be conducted periodically by the Management and Administrative people of an organization for the benefit of the stakeholders.

### **1.4. Environment Friendly Campus**

As stated earlier, Organization is liable to provide an eco-friendly atmosphere along with good quality of drinking water facility to all the stakeholders. Manuring the cultivated plants/grown within the campus may applied with organic manure, cow dung, farmyard manure and vermicompost instead of using chemical fertilizers. All non-compostable and single-use disposable plastic items, plastic utensils, plastic straws and stirrers should be avoided. Demonstration / awareness programme on establishing plastic-free environment and utility of organic alternatives for all incoming and current students, staff and faculty should be organized. Reduction of use of papers alternated with e-services, e-circulars, etc., and proper disposal of wastes, recycling and suitable waste management system should be considered to establish environment friendly campus.

The term ‘auditing’ is to examine the management practices and to evaluate performance of an organization in relation to environmental issues. World along with Associated Chambers of Commerce and Industry of India (ASSOCHAM), Green Building Council (IGBC) and Green Ratings Systems (GBCRS), Green Rating for Integrated Habitat Assessment (GRIHA), Bureau of Energy Efficiency (BEE), Leadership in Energy and Environmental Design (LEED), CII-GreenCo –GreenCo Rating System (CII-GRS), Food Safety Management System & Occupational Safety & Health (FSMS), Swachh Bharath under India Clean Mission (SBICM) and International Standard Organization (ISO 2021) have formulated a series of standards in the field of environmental auditing. These standards are basically intended to guide organizations and auditors on the general principles common to the execution of environmental audits.

Green Audit (ISO/IEC 17020:2012) comprised green campus, environment, energy, waste management (solid, liquid, municipal sewage, biomedical, plastic and electronic wastes), water, soil, air quality and hygienic audits are playing important role in Academic Institutions, R&D Organizations and Industries towards the accreditation process as well as maintaining a hygienic eco-friendly environment to the stakeholders

in their campus. All audits will be conducted as per the Government Law and Environmental and the concept of Swachh Bharath Abhiyan under Clean India Mission.

### **1.5. About Nature Science Foundation (NSF)**

NSF is the ISO QMS (9001:2015), EMS (14001:2015), OHSMS (45001:2018) & EnMS (50001:2018) Certified and registered with Ministry of Micro, Small and Medium Enterprise (MSME), Government of India Organization functioning energetically towards the noble cause of nature conservation and environmental protection. NSF is managed by a Board of Trustees which is a Public Charitable Trust registered under the TN Societies registration Act 1975 (TN Act 27 of 1975) on 29<sup>th</sup> November, 2017 at Peelamedu, Coimbatore 641 004, Tamil Nadu, India with Certificate of Registration No. 114 / 2017. In addition, NSF has 12AA, 80G and Form 10AC certificates for income tax exemption and implanting various Government schemes. The main motto of the NSF is 'Save the Nature to Save the Future' and 'Go Green to Save the Planet'. NSF family is wide spread across India with over 150 State wise Lead Auditors, Technical Experts and Auditors in training to conduct Green Audit.

NSF is functioning strenuously to conduct different awareness programmes and implement various schemes to public and school / college students towards the noble cause of nature conservation and environmental protection. Some of the programmes are also being organized for the benefit of tribal communities to create the supply chain for biodiversity conservation studies. The objectives along with vision and mission are illustrated to promote educational and environmental awareness programmes through social activities for enhancing the quality of life and to conserve nature from environmental pollutants using traditional and modern technologies for sustainable land management. NSF is educating the tribal community children through social service and towards the upliftment of tribes as a whole and make them as entrepreneurs.

International Eco Club Student Chapter (IECSC) has been established for student volunteers and faculty members are encouraged to conduct National and International events pertinent to biodiversity and natural resource conservation including environmental protection. NSF is being released 'Magazine' and 'Quarterly Newsletter' to share the information about environmental awareness programmes on biodiversity conservation in Western Ghats of Southern India. In order to encourage the students, faculty members, academicians, scientists, entrepreneurs and industrial experts those who are involving in nature protection and biodiversity conservation activities across the world, NSF tributes the deserved meritorious candidates with various awards / honours and these awards will be conferred to them during the Annual Meet and Award Distribution Ceremony which will be conducted every year.

Apart from the green audit which comprised of environment, energy, waste management, water, soil, air quality and hygienic audits, NSF has introduced academic & administrative audits including gender audit, biodiversity audit and ISO audit as per the checklist prepared by the NSF in compliance with Government Law and Environmental Legislations including Green Building Code and the concept of Swachh Bharath Abhiyan under Clean India Mission. These audits will be of more useful to Academic Institutions, R&D Organizations and Industries towards the accreditation

process as well as maintaining a hygienic eco-friendly environment to the stakeholders in their campus.

### **1.6. About the Organization**

MEA Engineering College, the first NAAC accredited self-financing engineering college in Malappuram district, is committed to provide excellent and value-based education with a flair for ethics and professionalism. The College is located amidst panoramic natural beauty over-looking the hills and valleys at Nellikunnu, near Perinthalmanna – a city of various educational institutions- on the Perinthalmanna- Melattur road. The College is easily accessible by road, rail and air. The College is governed by the MEA sponsored by the “Samastha Kerala Jammiyyathul Ulama”, a society instituted by top class intellectuals of the Muslim community. Janab Panakkad Sayed Sadique Ali Shihab Thangal is its charismatic head. The institution is affiliated to the APJ Abdul Kalam Technological University and approved by the AICTE..

### **Vision**

To provide top class education to the community by achieving excellence in engineering education and mould world class engineers with competence, integrity and social commitment.

### **Mission**

To provide the best faculty, excellent infrastructure, commendable facilities for excellent academic ambiance to encourage research and development and to strengthen employability and campus placements





1. **Date of Audit** : **20.11.2023**
2. **Audit Site** : **MEA Engineering College**  
Perinthalmanna, Mallapuram – 679 325,  
Kerla, India
3. **Inspection Body** : **Nature Science Foundation**  
Coimbatore, Tamil Nadu, India.
4. **Audit Scope** : **Green, Environment and Energy Audits as per  
ISO/IEC 17020:2012**
5. **Name of the Auditing Chairman** : **Dr. S. Rajalakshmi**  
ISO QMS, EMS, OHSMS and EnMS Certified  
Lead Auditor, Founder & Chairman of NSF.
6. **Name of the Auditing Team  
Leader** : **Dr. D. Vinoth Kumar**  
ISO QMS, EMS and EnMS Certified Lead Auditor  
& Joint Director, NSF.
7. **Name of the Lead Auditor for  
Green Audit+ Air Quality Audit** : **Dr. R. Mary Josephine**  
ISO EMS and EnMS Certified Lead Auditor.
8. **Name of the Lead Auditor for  
Environment Audit + Hygiene  
Audit** : **Ar. N. M. Pradeep Kumar**  
ISO EMS and IGBC Certified Lead Auditor.
9. **Name of the Lead Auditor for  
Energy Audit** : **Er. A. Karthick**  
Bureau of Energy Efficiency Certified Auditor.
10. **Name of the Lead Auditor for  
Waste Management + Soil &  
Water Audit** : **Dr. D. Vinoth Kumar**  
ISO QMS, EMS and EnMS Certified Lead Auditor  
& Joint Director, NSF

### **MEA Engineering College -Infrastructure**

#### **1.7. Audit Team Details**

#### **1.8. List of Instruments used in the Inspection Process**

During the on-site visit the below listed instruments are used by the Lead Auditors and Technical experts to check the specific parameters in the view of maintaining sustainability. All the instruments are calibrated by ISO 17025 accredited labs (JRST Technical Services, Chennai, Tamil Nadu and Instruments Calibration and Test Centre, Coimbatore, TN). The frequency of calibration is six months once or 20 times after its use.

### 1.8.1. Oxygen Meter

Oxygen meter is used in the audit process to measure the oxygen level in the organization. The instrument is calibrated after using 20 times. Suitability of the instrument are range between 0 to 30% O<sub>2</sub>, resolution of 0.1%, accuracy is  $\pm$  (1% reading + 0.2% O<sub>2</sub>), response time is  $\leq$  15 seconds, environment pressure range is 0.9 to 1.1 atmosphere, temperature range is 0 °C to 50°C, 32°F to 122°F, temperature resolution is 0.1°C, temperature accuracy is 25°C.



### 1.8.2. Carbon dioxide meter

Carbon dioxide meter is to measure the carbon level in the organization. The instrument is calibrated after using 20 times. Suitability of the instrument are range between 0 ~ 4000 ppm, resolution of CO<sub>2</sub> Meter is 1 ppm, accuracy is  $\leq$  1,000 ppm, repeatability is  $\pm$  20 ppm, temperature range between 0°C to 50°C, 32°F to 122°F, temperature resolution is 0.1°C, temperature accuracy is at 25°C.



### 1.8.3. Light (LUX) Meter

Light meter is to calculate the light intensity in the organization. Suitability of the instruments are, 5 ranges. i.e., 40.00, 400.0, 4,000, 40,000, 400,000 Lux, operating temperature is 0 to 50°C, Operating humidity is less than 80% RH, Power consumption is DC 8 mA approximately. This Instrument will be calibrated yearly once or during non-functioning.



### 1.8.4. Sound Level Meter

Sound level meter is to measure the noise level in the organization. This instrument is calibrated yearly once or after using 20 times. Suitability of the instruments are measurement range is 30 – 130 dB, resolution is 0.1 dB, accuracy is (23 $\pm$ 5 °C), Frequency of the instrument is 31.5 to 8,000 Hz, Operating temperature is 0 to 50 °C (32 to 122 °F), Operating humidity is less than 80% RH, Power consumption is DC 6 mA approximately.



### 1.8.5. pH Meter

pH meter is generally used to measure the pH level in water. It is calibrated 6 months once or after 20 times of its use. Suitability of the instrument are range of the pH meter is 0 – 14, accuracy is  $\pm$  2%, resolution of the instrument is 0.1 pH, operating temperature is 0 to 50 °C (32 to 122 °F).



### 1.8.6. TDS Meter

TDS meter is generally used to measure the TDS level in water. Suitability of the meter are range of TDS meter is 0 – 9990 ppm (mg/L), operating temperature is 0 to 80 °C (32 to 176 °F) and accuracy is  $\pm 2$  %. This meter is calibrated six months once or 20 times after its use.



### 1.8.7. GPS Meter

GPS meter is subjected to know the latitude and altitude, location, etc., Suitability of the GPS meter are, dimension is 2.1" x 4.0" x 1.3" (5.4 x 10.3 x 3.3 cm), Display resolution is 128 x 160 pixels an GPS Map features included in Continental Europe. It is calibrated six months once or after 20 times of the usage.



### 1.8.8. Deluxe Water and Soil Analysis Kit

Deluxe water and soil analysis kit is used to analyze the pH, TDS, salinity, turbidity, alkalinity dissolved oxygen of water.



### 1.8.9. Digital Clamp (Voltage) Meter

It is used to check the input and output voltage between two points of an electrical circuit of Alternating Current (AC) and Direct Current (DC) by means of the high resistance of the voltage that impede the flow of current.



## 1.9. Use of Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) refers to protective clothing for the eyes, head, ears, hands, respiratory system, body, and feet. It is utilized to protect individuals from the risks of injury while minimizing exposure to chemical, biological, and physical hazards. PPE serves as the final line of defense when engineering and administrative controls are insufficient in reducing risks. Nature Science Foundation safeguards all the auditors by supplying PPE during the conduct of audits. PPE used are safety jackets, ear plugs, goggles, face shield, hand gloves, shoes, etc.,

### 1.9.1. Safety jackets:

PPE includes safety vests and suits that can be used for inspection process which will protect body injuries from extreme temperatures, flames and sparks, toxic chemicals, insect bites and radiation.



### 1.9.2. Goggles and Face shield:

Goggles and face shield are used in the inspection process while inspecting items which would cause eye damage or loss of vision, spray or toxic liquids especially in chemistry labs, nearing the electric and electronic item.



**1.9.3. Helmet:**

PPE includes hard hats and headgears which will be required for tasks that can cause any force or object falling to the head. It also helps to resist penetration.



**1.9.4. Hand gloves:**

PPE includes safety gloves and should be used for tasks that can cause hand and skin burns, absorption of harmful substances, cuts, fractures or amputations. Selection of hand gloves is based on the application of use.



**1.9.5. Safety Boots:**

Foot protection is one of the most commonly used PPE and can differ depending upon the environment. Safety boots are used for tasks that can cause serious foot and leg injuries from falling or rolling objects, hot substances, electrical hazards, and slippery surfaces.

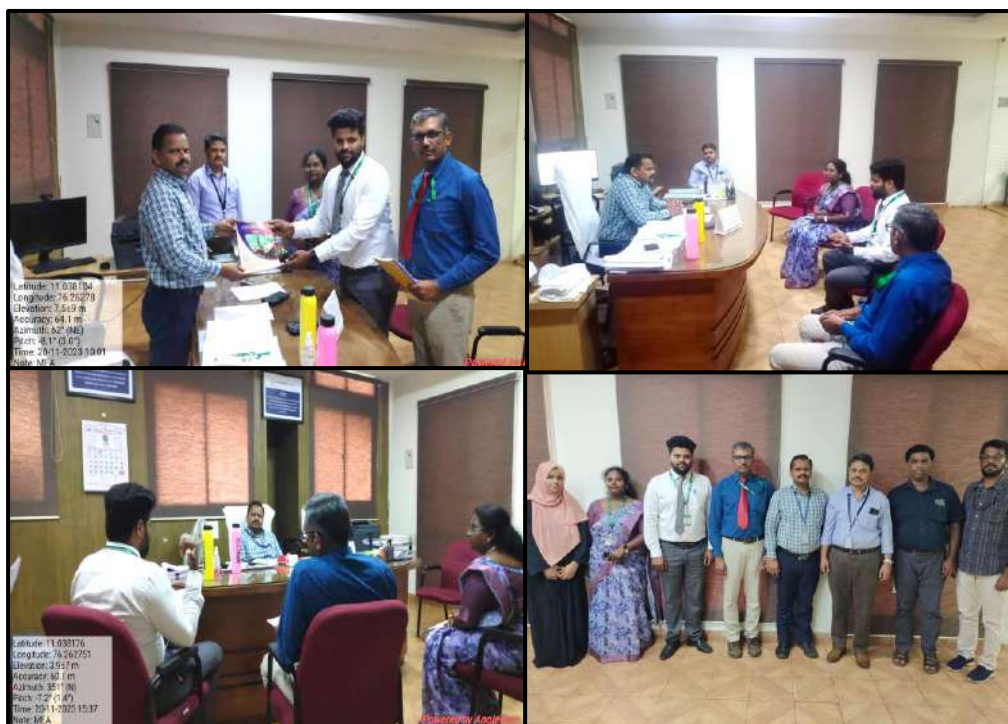


**1.9.6. Ear Plug:**

Ear plugs are used for tasks that can cause hearing problems and loss of hearing. Hearing protection devices reduces the noise energy reducing reaching and causing damage to the inner ear. This ear plug is mostly used near sound producing devices like power motors, genets, generators, etc.,



**Opening and closing meetings with the Head of the Organization, NAAC / IQAC Coordinators and NSF Inspection Team**



## 2. GREEN AUDIT

### 2.1. Introduction

Green audit ensures the Organization's campus should have greenish with large diversity of trees, herbs, shrubs, climbers and lawns to reduce the environmental pollution and soil erosion; it is also useful in relation to biodiversity conservation, landscape management, irrigation/economic water utilization and maintenance of natural topography besides vegetation (Gamble and Fischer, 1972). For the benefit of stakeholders, solid waste management, recycling of water, disposal of sewage and waste materials (electronic and biomedical wastes), 'zero' use of plastics, single use plastic items, etc. should be followed consistently in the organization campus. Green Audit procedures includes the definition of green audit, methodology on how to conduct green audit at Educational Institutions and Industrial sectors as per the checklist based on National Building Code (NBC) Part 11 - Approach to sustainability and assessment of risk at 360° view (Arora, 2017).

### 2.2. Importance of green audit

The Management of the Organization (Auditee) should be exposed their inherent commitment towards making ecofriendly atmosphere through the green auditing and ready to encourage/follow all types of green activities (Leal Filho *et al.*, 2015). A clean and healthy environment will enhance an effective teaching/learning process. They should create the awareness on the importance of greenish initiatives through environmental education among the student members and research scholars. Green audit is the most effective, ecological approach to manage environmental complications (Rajalakshmi *et al.*, 2022).

Green audit is a kind of professional care and a simple indigenized system about the environment monitoring in terms of planting more number of trees which is a duty of each and every individual who are the part of economical, financial, social and environmental factors. Green audit is a professional and useful measure for an Organization to determine how and where they are retaining the campus eco-friendly manner. It can also be used to implement the alleviation measures at win-win situation for the stakeholders and the planet. It provides an opportunity to the stakeholders for the development of ownership, personal and social responsibility.

### 2.3. Aims and objectives of green audit

- a. To recognize the initiatives taken towards establishing the green campus in terms of availability of flora and fauna diversity within study area.
- b. To assess the greenish nature of an organization campus in terms of available vegetation which reflects on reducing the environmental pollution, soil erosion, biodiversity conservation, landscape management, natural topography and vegetation.
- c. To grow a greater number of oxygen releasing and carbon dioxide assimilating plants in the campus to give a pure atmosphere to the stakeholders.
- d. To identify and provide baseline information to assess the risk to the ecosystem due to developmental activities of the organization and resolve the same.

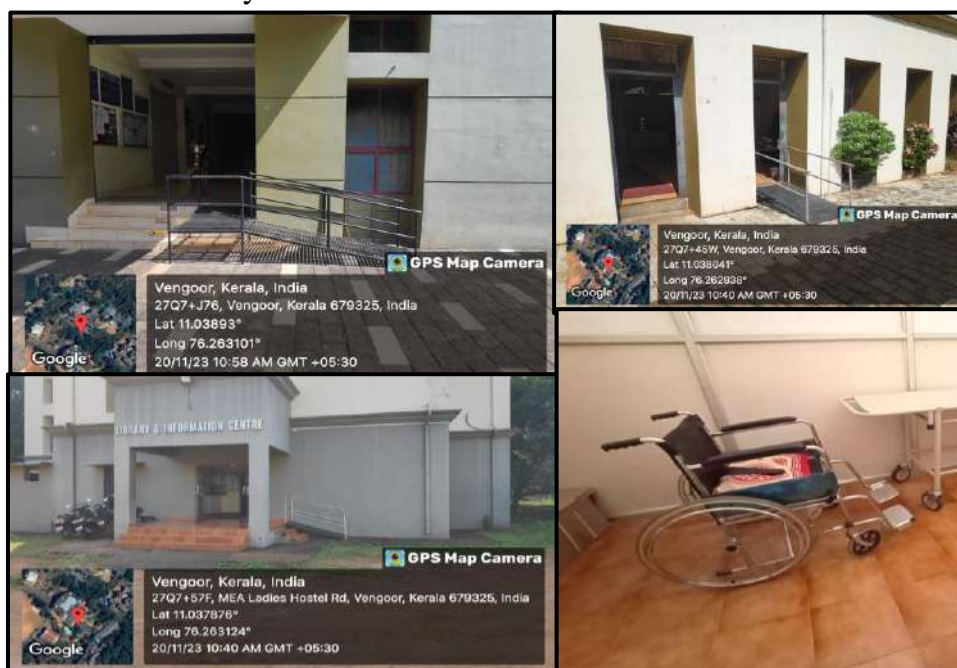
- e. To ensure proper utilization of resources available in the surrounding areas towards future prosperity of the humanity.
- f. To fix a couple of norms for disposal of all varieties of wastes and use green cover as a carbon sink.

## 2.4. Green audit observations

- It is observed that the Organization has facilities like ramp walk, wheel chair, rest rooms, etc., for disabled and different age group people.
- Monitoring plan is available for the periodic checking at proper time interval to maintain sustainability.
- Adequate training and awareness programmes are conducted to the Stakeholders for sustainable development at all stages of building life cycle.
- More than 30% of open space is maintained as soft scapes (vegetation) to lower the energy conservation in the campus.
- Land scape design are planned to maintain the natural capacity of the site.
- Vegetation are available around the building to reduce energy consumption and maintain indoor climates.
- Soil health is maintained well without using any chemical fertilizers.
- Ecological design / conserving biodiversity such as Transplantation, climate and design in accordance with bio diversity, reduced pesticides and other activities are not applicable because no new construction is planned and raised.
- Plant and animal species are monitored by conducting the periodic survey in the Organization.

### 2.4.1. Facilities for Human Comforts

As per the National Building Code part 11 (Approach to Sustainability) under elements of sustainability quality of plumbing services and buildings are maintained in line with the standard. Ramp walk facilities are implemented for the benefit of disabled and different age group people. Accessible toilet facilities are observed for the comfort of person with disability.



### 2.4.2. Natural topography, vegetation and monitoring

Natural topography means the original geographical features and natural resources of the Site. It is observed that the organization has the natural features like rocks, water resources, slopes, landscape, pathways, etc. Vegetation is the cultivation of a bunch of plants irrespective of the plant *taxa* for the covering of the area or ground topography. The observation at the campus indicated that there are more than 30% natural topography and vegetation. Monitoring plan for maintaining the vegetation and sustainability are evident through separate operation and maintenance team & their records for regular watering as per the micro climatic condition through irrigation.



**Natural Topography and Vegetation at the Campus**

### 2.4.3. Landscape design and soil erosion control

Landscape design is an important feature for any disasters to control especially with respect to the soil erosion. In general, soil erosion occurs if the design of the land is not altered so as to prevent the slope features by strong vegetation and use of a plant buffer zone as safe for escape of nutrients or fertilizers entering the streams. Observation revealed that the audited site has very good landscape design without disturbing the natural vegetation. Contour ploughing is being done at right angles to the slope wherever possible and ridges and furrows are properly maintained to break the flow of water down to the empty land. These activities are widely adopted to control soil erosion in the campus.



**Landscape design were observed in the campus to control the soil erosion**

#### 2.4.5. Establishment of different gardens, vertical landscaping and roof gardens

It is observed that Organization maintain certain biomass critical for human health and also to reduce the bio-retention through water flow rates different types of garden like ornamental is implemented in the campus



**Ornamental Garden observed in the Campus**

#### 2.4.6. Survey of Flora and Fauna

Ensuring the rich biodiversity in the green campus is an important parameter which reflects the real-time ecosystem. In general, plants improve the outdoor air quality with increased oxygen levels and reduced temperature and carbon dioxide. The record on maintenance of the plant biomass and its management are important with respect to green campus initiatives. The existence of such plants and birds in the green campus are recorded for the rich flora and fauna which are being considered as a value addition to the campus.

It is evident that regular flora and fauna survey were performed by the Organization and they predominant species are listed in the Table 1. Various vascular plant species were identified and plant specimens were freshly collected and their digital photographs were taken. The collected plant specimens have been identified using 'The Flora of the Tamil Nadu Carnatic' (Matthew, 1983) using the suitable Technical Experts. The most plants recorded are *Azadirachta indica*, *Pongamia pinnata*, *Mangifera indica* and *Cycas revoluta* which are dominant trees species characteristic to the vegetation within the campus. Some of the shrub species like *Nerium oleander*, *Nerium indicum*, and *Dyopsis lutescens* are also rather common in the campus. Ground flora is comparatively sparse but fairly rich in undistributed areas. Some of the common weeds like *Euphorbia hirta* is found to be predominant. Species such as *Catharanthus roseus*, *Cynodon dactylon* are some common herbs in the campus. This campus is rich in grass species like *Andropogon pumilis*, *Apluda mutica*, *Cenchrus ciliaris*, *Asparagus racemosus* and *Commelina benghalensis*. Most of the species found are common in the campus, some of the species *Cucumis dipsaceus*, *Hybanthus*, *Bothriochloa compressa* and *Caralluma bicolor* is the rare species. Some endemic grass species like *Andropogon pumilus*, *Panicum psilopodium* and *Perotis indica* are also occurring in the campus.

The observations on fauna diversity indicated that the campus has a large number of living as well as visiting mammals, birds, grasshoppers, reptiles and termites. The campus has different family level diversities such as Papilionidae, Pieridae, Nymphalidae and Lycaenidae in which common butterfly species such as Mormon,



Rose, Birdwing, Emigrant, Grass yellow, Gull Wanderer, Small Orange Tip, Plain Orange Tip, White Orange Tip, Evening and Grey are commonly observed. Grasshoppers, a group of insects belonging to the suborder Caelifera and they are probably most ancient living group of chewing herbivorous insects. Termites are most successful groups of insects on earth, colonising most landmasses which are also observed in the campus. Birds were observed by visual sightings and by calls also the avifaunal data were observed through the photographs. Reptiles and Amphibians are identified based on coloration, markings on the skin, background colour generally brown through subject experts (Beebee and Griffiths, 2000).

**Table 1. List of Flowering plants in the Campus**

S.No	Common Name	Botanical Name	Family	Habitat
1.	Amla	<i>Emblica officianalis</i>	Phyllanthaceae	Tree
2.	Bamboo tree	<i>Bambusa vulgaris</i>	Poaceae	Tree
3.	Ficus	<i>Ficus benjamina</i>	Moraceae	Tree
4.	Mango tree	<i>Mangifera indica</i>	Anacardiaceae	Tree
5.	Badam	<i>Terminalaia Cattappa</i>	Combretaceae	Tree
6.	Kumil Teak	<i>Gmelina arborea</i>	Lamiaceae	Tree
7.	Fig	<i>Ficus carcia</i>	Moraceae	Tree
8.	Mahogany	<i>Switenia macrophyella</i>	Meliaceae	Tree
9.	Redpalm	<i>Cryptostachys venda</i>	Avecaceae	Tree
10.	Mangium	<i>Acacia mangium</i>	Fabaceae	Tree

**Predominant Plant species found in the Campus**



***Hyophorbe lagenicaulis***



***Ixora coccinea***



***Mangifera indica***



***Rhapsis humilis***



***Howea forsteriana***



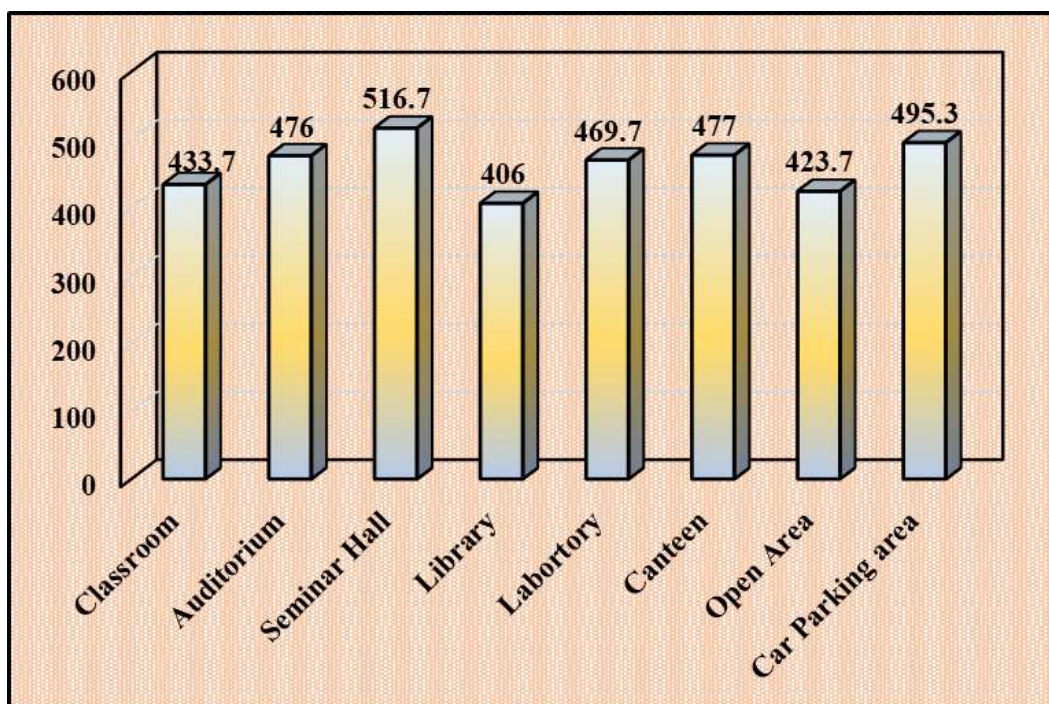
***Ficus auriculata***

## 2.5. Measurement of carbon dioxide level in the campus

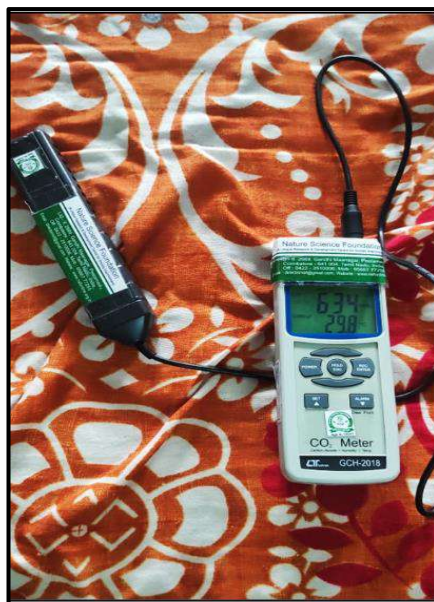
Climatic conditions of the earth changed now-a-days due to a massive increase in global warming and environmental changes including human population and human activities. In addition, primarily fossil fuel burning and an extensive usage enhances heat-trapping greenhouse gas levels in the atmosphere. Global warming is driven by human-induced emissions of greenhouse gases which resulted in paramount shifts in weather patterns. In general, a portable CO<sub>2</sub> Analyzer is used to measure the level of carbon dioxide in the atmosphere at different places across the campus.

**Table2. Measurement of CO<sub>2</sub> concentration in the Organization**

S.No.	Different locations of the Organization's Campus	Carbon dioxide level (ppm)*	Remarks
1.	Classroom	433.7	Within permissible limits
2.	Auditorium	476.0	Within permissible limits
3.	Seminar Hall	516.7	Within permissible limits
4.	Library	406.0	Within permissible limits
5.	Laboratory	469.7	Within permissible limits
6.	Canteen	477.0	Within permissible limits
7.	Open Area	423.7	Within permissible limits
8.	Car Parking area	495.3	Within permissible limits
	Mean	410.89 %	
	SEC ±	3.30	
	CD at P=0.05%	5.88	



**Figure 1. Measurement of CO<sub>2</sub> concentration in the Organization**



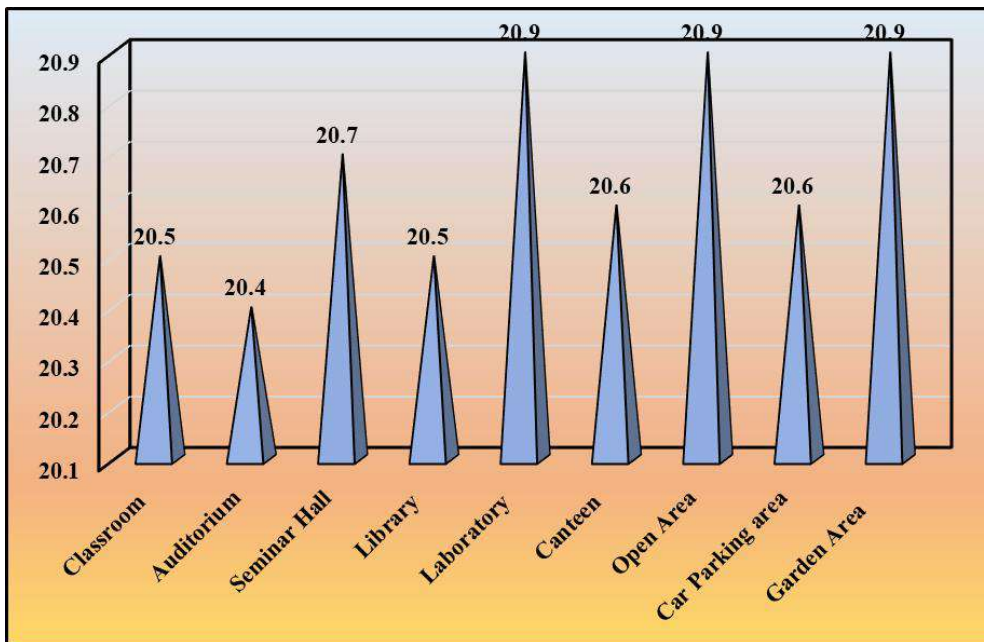
### Measurement of CO<sub>2</sub> level at the College Campus

#### 2.6. Atmospheric oxygen level measurements analysis and interpretation

Oxygen level refers to the amount of oxygen available within the atmosphere or water bodies. Oxygen is produced/released as a by-product of photosynthesis, the metabolic activity of all green plants besides certain microbes. Oxygen plays a paramount role in metabolic activities like respiration and the energy-producing chemistry of all living organisms. In order to quantify the oxygen level, Oxygen Meter is used. The atmosphere contains 18-21% oxygen concentration, 75-78.5% nitrogen and 2-3% other gases like carbon dioxide, neon and hydrogen. The amount of oxygen level in the atmosphere is determined by abiotic factors like altitude, latitude and longitude and biotic factors like plantations in the surroundings. If oxygen level is low in the atmosphere lead to headaches and shortness of breath to human beings. If it excess, it causes oxygen toxicity and oxygen poisoning by creating coughing, breathing trouble and damage the lungs to human beings. The oxygen level of different places at the campus are monitored and presented (Table 3).

**Table 3. The oxygen concentration at different places of audited organization**

S.No	Location	Oxygen Level (%) *	Remarks
1.	Classroom	20.5	O <sub>2</sub> level is good
2.	Auditorium	20.4	O <sub>2</sub> level is good
3.	Seminar Hall	20.7	O <sub>2</sub> level is good
4.	Library	20.5	O <sub>2</sub> level is good
5.	Laboratory	20.9	O <sub>2</sub> level is good
6.	Canteen	20.6	O <sub>2</sub> level is good
7.	Open Area	20.9	O <sub>2</sub> level is good
8.	Car Parking area	20.6	O <sub>2</sub> level is good
9.	Garden Area	20.9	O <sub>2</sub> level is good
	Mean	20.36%	
	SEC ±	0.17	
	CD at P=0.05%	0.30	



**Figure 2. The oxygen concentration in the Organization**



**Measurement of O<sub>2</sub> level at the College Campus**

### 3. ENVIRONMENT AUDIT

#### 3.1. Introduction

Environmental (Eco) audit is quantitative and qualitative data to track air, soil and water and to gain actionable insights to improve the operational performance in the atmosphere. It provides a 360° view of a surrounding campus and makes it easy for Owners / Managers / Environmentalists to collaborate, measure, control and reduce environmental negative impacts. Finally, it leads to enhance the quality of life of all living organisms. Eco audit initiatives are the need of the hour across the world due to changing environmental conditions and global warming besides ever-increasing human population and anthropogenic activities (NCP, 2016). Eco audit aims to make a sustainable and friendly environment for the stakeholders. In this context, to conserve eco-friendly atmosphere of an organization, well-developed environmental objectives and targets should be undertaken to reduce the harmful effects to a greater extent (Gnanamangai *et al.*, 2022).

The audit process can remarkably minimize the environmental pollution in the campus which in turn reduces the impact of global warming scenario. As per the Rules and Regulations laid by Government, the environmental legislations should be followed by all the Institutions and Organizations and make sure that their activities should not degrade the environment (Vinoth Kumar *et al.*, 2021). The environmental audit involves systematic documentation of periodic objective review by a regulated entity on available facilities, their operations and practices related to resolve the environmental requirements. In general, environmental audit is planned to achieve an optimum resource utilization and improved process performance in the audit sites. Venkataraman (2009) stated that it is a 'Common Sense Approach' to identify the problems and solve those problems pertaining to curb eco-friendly atmosphere (Aparajita, 1995; APHA, 2017). Environmental audit enables an overall and complete overview at the audit sites to facilitate our understanding of flow of materials and to focus the priority areas where waste reduction is achieved thereby cost saving is made possible.

Purpose of the audit is to determine performance of the environmental management systems and equipment related to environmental safety. Audit reports can provide key information to the management in relation to risk areas, progress towards strategic objectives and targets. Audit work can be undertaken voluntary for the benefit/advantage of the company and it can be executed with the help of environmental auditing authorities. As mentioned earlier, it helps in the proper natural resource utilization and on the whole, it improves the quality of environment.

An environmental auditor will study an organization's performance towards the environmental sustainability in a systematic manner where environmental management systems and equipment are performing with the aims of a) facilitating management control of environmental practices, b) assessing compliance with company policies, c) facilitating professional competence, d) sustenance activities without harming the environment and e) practicing the environmental conservation.

### 3.2. Aims and objectives of environmental audit

Primary objective of an Environmental audit is to promote the environmental safety management and preservation of natural resources for future generations. Major objective of environmental audit confined to:

- a. Protecting the environmental health and minimise the threats posed to human safety by the performance of the organization
- b. To adopt measures to reduce water consumption, waste generation and waste water recycling
- c. Evaluation and documentation of wastewater quality, its characteristics and their effects on living system
- d. Maintenance of labour/occupational health & medicine followed by proper documentation of environmental compliance status
- e. Annual environmental auditing will render educated to overcome existing issues and to conduct outreach programmes to the public.
- f. To establish a baseline information about the eco-friendly environment in the campus and to create consciousness among the stakeholders about the requirement of clean environment and its conservation

### 3.3. Procedures followed in environment audit

Environment audit involves monitoring an organization concerning about the green campus, environment, sanitation and hygiene policies. It is a regular process that is conducted periodically by a regulated entity to check whether an organization meets the requirements of environmental compliance. The process of environment audit includes examining, collecting, evaluating, documenting the data and analysing various components related to environmental aspects and carried out as per the procedures mentioned of the Manual of Gnanamangai *et al.*, (2021). It is a customary stepwise process where it starts with opening meeting among the audit team and auditees and completed with closing meeting. However, any specific parameter comes under this section will be highlighted hereunder.

- During onsite audit it has been monitored and documented the components as per the environment audit checklist in line with National Building Code (Part 11 – Approach to Sustainability).
- To observe the water and waste management activities.
- Steps taken to reduce the heat island effect mainly in car parking areas, etc.
- Collect information about Ecology and Environment studies, awareness programmes conducted and publications with respect to Environment.

#### 3.3.1. Organization Details

**Table 2. Campus details**

S.No.	Details / Descriptions	Quantity
1.	Total strength of Students	989
2.	Total strength of Employees	158
3.	Total number of Buses in the campus	9
4.	Number of Cars entering in the campus	15
5.	Number of Motorcycles entering in the campus	70

6.	Number of other vehicles (Lorry, Ambulance, Jeep, Trucks, Cranes, Poclain, and etc. entering in the campus)	02
7.	Number of E-Vehicles	05
8.	Number of RO Water Plants	01
9.	Number of Borewells	01
10.	Number of Open wells	03
11.	Number of Percolation Ponds	Nil
12.	Number of Water treatment facility	01
13.	Number of Rain harvesting system	01
14.	Number of Composting pits and Vermicompost units	01

### 3.4. Environment audit observations

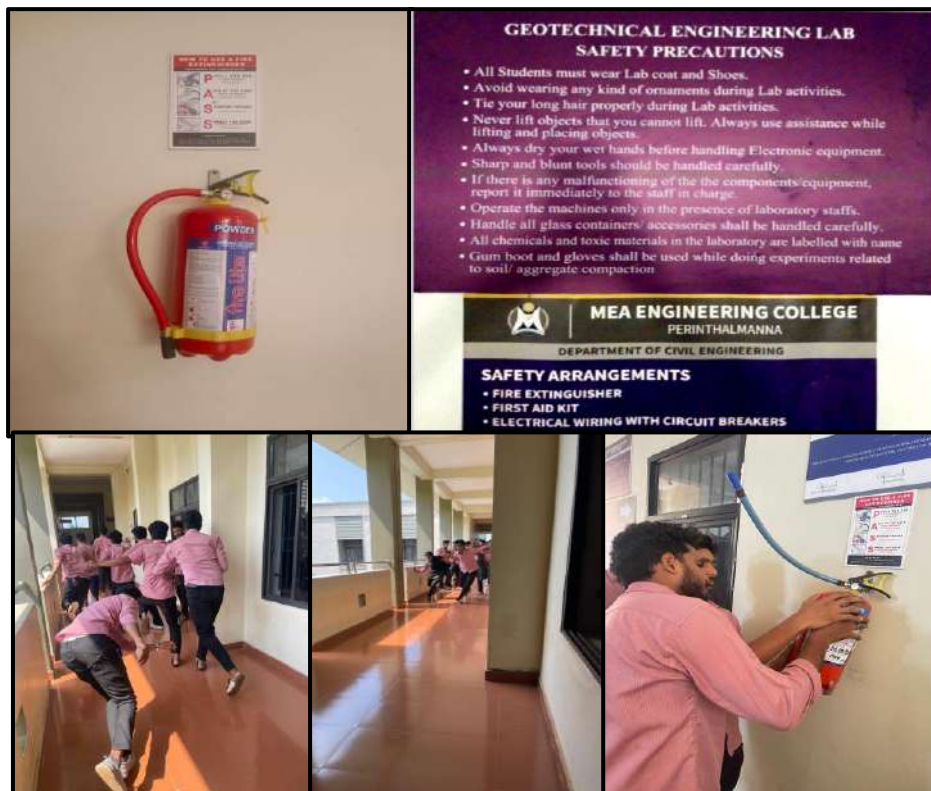
- The construction is proposed based on the applicable climatic zone and geological conditions.
- Human comforts are implemented and observed like ramp walk, fire safety, etc.,
- To reduce the demand of water, rain water harvesting system is implemented and used for irrigation facilities.
- Training and awareness programmes records are available to maintain sustainability.
- Fire hydrant system is available in the building to consider the safety of all the Stakeholders and maintained properly.
- It is observed that the mock drills and awareness programmes are conducted for disaster management.
- Retaining wall is built near the drainage and vegetation has been planted to avoid the surface soil run off.
- Paver block to increase the percolation of rain water to ground are implemented and practiced.
- Parking is provided under the shade to reduce the Heat Island effect (Temperature).
- Rain water harvesting unit is maintained well without using any chemical, the water is used for irrigation purpose.
- Public transport facilities are available in the campus to control air pollution.
- The pedestrian pathways are maintained with adequate shading facilities by planting more number of trees.
- No offsite and subsidized parking are encouraged in the campus.
- Waste is segregated before the disposal.

=

#### 3.4.1. Safety measures and green building conservation code

Environmental safety measures are very important in the buildings as far as students, staff members and other stakeholders are concerned and it requires vigilance and awareness Organization work to foster safe environments; however, students honestly share equal responsibility. Management should extend by issuing guidance and the best safety tools. The organization has have a police force, escort services, call boxes, first aid box, fire extinguishers, fire alarms, security systems and staffs towards the safety measures. Organization has very good safety measures as per the green

building conservation code such as fire extinguisher and fire bell and alarms in all the place. In addition, in all the place, 'Exit', 'Entry' and other sign boards kept across the place to give safety to the stakeholder. It is observed that Fire Extinguisher are maintained properly which is evident through AMC. Regular mock drill and awareness programmes are conducted at regular intervals considering the safety of stake holders.



**Fire Extinguisher and Mock drill awareness implemented in the College.**

### **3.4.2. Parking facilities to reduce Heat Island Effect**

Heat island effect denotes the temperature level. It is observed that the vehicles are parked under the Tree shade and under albetos roof to reduce the heat island effect for the benefit of stakeholders and to maintain sustainability. To reduce the heat island effect parking areas are made up of high albedo materials with light colored paints observed in the organization.

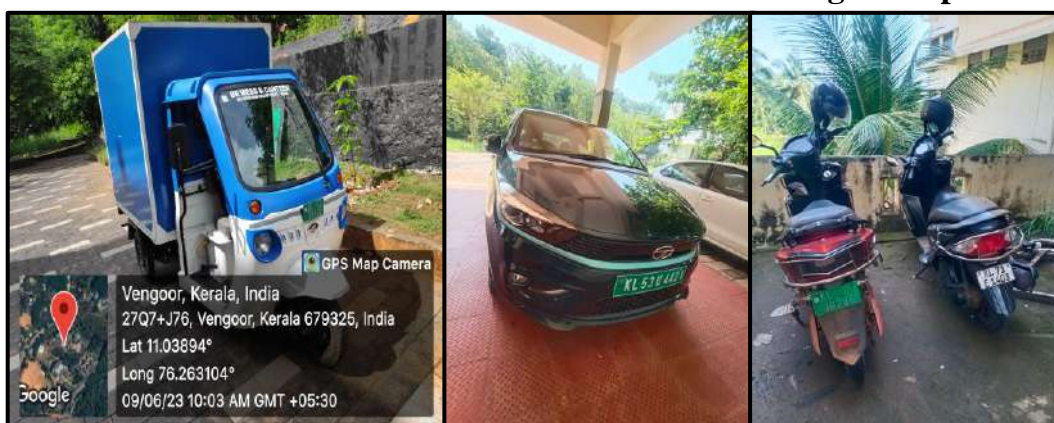
### **3.4.3. Public transport, low emitting vehicles and control of car smokes**

Utility of public transportation (buses) reduces carbon emissions greatly and decreases the development of smog within the towns. This means that human beings have healthy air to respire. Comparing a bus travelling with a car transport for a person, it has been observed that buses are the most effective system by producing lower quantum of emission of carbon when compared to that of car transport. This will be a huge decrease in utility of natural resources per person. Other than this, it also gives more benefits like less noise and traffic congestion. Whenever possible, try to take public transport in place of one's own vehicle. Apart from the e-vehicles, students are encouraged to use bicycles.





**Vehicles are Parked at Under the shades in the College Campus**



**E- Vehicle usage in the College Campus**

### 3.4.4. Auditing carbon footprint

Carbon footprint means measuring/recording the greenhouse gases (GHG) emissions of an organization within its defined boundary. Burning fossil fuel emits carbon which accumulate in the atmosphere if there is not sufficient bio capacity dedicated to absorb the same. Commutation of stakeholders has an impact on the environment through the emission of greenhouse gases consequent to burning of fossil fuels. The most common greenhouse gases are carbon dioxide, methane, nitrous oxide and ozone; among them, carbon dioxide is the prominent one. An important aspect of doing an audit is to access the impact within defined boundary which can help to derive better ways to minimise its impact. It is necessary to assess the carbon footprints of an organisation to understand how far they are contributing towards sustainable development. It is therefore essential that any environmentally responsible organizations should examine their carbon emission and be subjected to calculate carbon footprint (Woo and Choi, 2013). Observations on carbon dioxide and oxygen levels



monitored in different parts of the campus are presented under Green Audit section while observation on carbon footprint due to electricity usage per year at the Organization along with other fossil fuel utility are presented under Energy Audit portion of this Technical Report.

### 3.4.5. Pedestrian path facility at the campus

The concept of pedestrian path is to give safe space to walk freely by the pedestrian. It is very important in the green campus in terms of freely walk pedestrians or people going on foot without any obstacles. The pedestrian path is otherwise called as zebra crossing by the combination of black and white stripes remained to characterize the zebra. In addition, pedestrian path is created in the green campus along with road side which meant for walking only using special cement bricks and stones. The pedestrian path aims to end circulation not only cars, buses, vans, trucks and other vehicles but also giving safe space to the pedestrians, where cross and pass through blocks and also forcing vehicles to comply with it. The audited organization is having very good facility in creating pedestrian path for stakeholders with all the facilities such as accessible public toilets, barrier free environment, dustbins, stone benches, etc. Use of bicycles are encouraged in the Campus to control carbon emission and air pollution.



### 3.4.6. Waste and Water management activities

Management of water and waste are the two important parameters which plays a vital role to maintain sustainability. Rainwater harvesting is implemented and maintained properly for water conservation, this water is used for irrigation and domestic purpose.



**Rainwater harvesting implemented and maintained properly for water conservation**



**Water Treatment Facilities in the College Campus**



**Water Management Activities in the College Campus**

### **3.4.7. Post Occupancy maintenance**

Post occupancy maintenance is the activities performed after the completion of construction work and handed over to the owner for further maintenance. The following activities are observed during the onsite visit as post occupancy maintenance

- Vegetation and plants are maintained properly with regular watering through gardener.
- Soil is maintained well without adding any chemical fertilizers and pesticides.
- Rainwater harvesting is available to meet the demand of water consumption.
- To reduce the energy consumption HVAC system are maintained properly.
- Considering the safety of the stakeholders fire extinguisher, health care room facilities are available.



**Post Occupancy Maintenance in the Campus**

### **3.4.8. Environmental education**

An environmental study is the learning principle of the ecosystem and how it will expand sustainable techniques to defend the surroundings. It enables people to develop an understanding of the environment in which we live and helps to overcome tough environmental troubles affecting nature. To create attention amongst today's generation on pressing environmental troubles, the University Grants Commission (UGC) in India has made it mandatory for the Universities and Autonomous Colleges to introduce a course in 'Environmental studies' and teach to the students about the ecosystem, pollution and problems associated with the environment.



**Environment studies syllabus to learn about Ecofriendly Atmosphere**

## 4. ENERGY AUDIT

### 4.1. Introduction

An energy audit is a survey in which the study of energy flows for the purpose of conservation is examined at an organization. It refers to a technique or system that seeks to reduce the amount of energy used in the Organization without impacting the output. The audit includes suggestions of alternative means and methods for achieving energy savings to a greater extent. Conventionally, electrical energy is generated by means of fossil fuels, hydraulic and wind energy. The availability of fossil fuels and their depletion rate, insist the need for alternate energy systems and conservation of conventional electricenergy. In general, the primary objective of an energy auditing and management of energy consumption is to offer goods or services at the lowest possible cost and with the least amount of environmental impact.

Energy Conservation Building Code (ECBC) is established in the year 2017, which provides minimum requirements for the energy-efficient design and construction of buildings across India. It also provides two additional sets of incremental requirements for buildings to achieve enhanced levels of energy efficiency that go beyond the minimum requirements. Bureau of Energy Efficiency (BEE) came into force in 2002 towards implementation of energy saving practices in an organization. Energy-efficiency labels are information affixed to manufactured products and usually communicate the product energy performance.

BEE Star Rating Scheme is based on actual performance of the building as well as equipment in terms of specific energy usage termed as ‘Energy Performance Indicator’ by means of star ratings labelled items used which will be useful for energy savings in a sustainable manner (Mishra and Patel, 2016). Energy audit programme provide aid in maintaining a focus on energy price variations, energy supply availability and efficiency, determining an appropriate energy mix, identifying energy-saving technology, retrofitting for energy-saving equipment and so on (Gnanamangai *et al.*, 2021, 2022; Rajalakshmi *et al.*, 2019). In general, an energy audit process dealt with the driving energy conservation concepts into reality by giving technically possible solutions within a specified time limit while considering the economic and other organizational issues. It also dealt with the uncover ways to cut operating expenses or reduce energy use per unit of production interms of savings. It serves as a “benchmark” for managing energy in the organization for planning more energy-efficient use across the board.

### 4.2. Aims and Objectives of an Energy Audit

An energy audit is a useful tool for developing and implementing comprehensiveenergy management plans of an organization. As mentioned earlier, aim of an energy audit is to identify the energy efficiency, conservation and savings opportunities at the audit sites in a systematic manner. The audit process involves following steps.

- Review of energy saving opportunities and measures implemented in an audit site.
- Identification of various energy conservation measures and saving opportunities.
- Implementation of alternative energy resources for energy saving opportunities and decision making.

- Providing a technical information on how to build an energy balance as well as guidance to be sought for particular application.
- Detailed analysis on energy consumption based on latest electricity bills and understanding the tariff plan provided by the Central and State Electricity Board.
- The utility of energy in terms of electricity, LPG, firewood, petrol, diesel and other resources to calculate carbon foot print analysis with in the campus.
- Utility of number if incandescent (tungsten) bulb and CFL bulbs, fans, air conditioners, cooling apparatus, heaters, computers, photo copiers, inverter, generators and laboratory equipment and instruments installed in the organization to calculate the energy utilization.
- Alternative energy sources / nonconventional energy sources are employed / installed in the organization (photovoltaic cells for solar energy, windmill, energy efficient stoves, Biogas, etc.).
- Creating awareness among the stakeholders on energy conservation and utilization.

### **4.3. Procedures followed in an energy audit**

Several methods are adopted in the energy audit, walk-through audit is one among them. The balance of total energy inputs with total energy outputs and identification of all energy streams in a facility are being taken into account. The amount of energy used by each of its energy streams are calculated as per the methodology mentioned in the audit Manual. The production process flow is studied and electricity consumption are measured. Location of the electrical machines, conditions of them and their accessories are inspected through physical verification as per the regulation of Indian Green Building Council and World Green Building Council. Physical verification of installed electrical appliances and when considering the cost or prospective cost savings in each of the above components, energy always wins and the energy management task becomes a key cost reduction area.

An energy audit is proposed and conducted to ensure that energy saving practices are implemented and followed in Educational Institutions and Industrial sectors in a sustainable way. Preparation and completion of a questionnaire, physical examination of the campus, observation and examination of documentation, key person interviews, data analysis, measurements and suggestions are all part of the audit process. Energy audit involves several facts including energy savings potential, energy management, finding alternatives, etc. It may be useful to check where carbon emission is prominent which could be taken into account to reduce. Finally, after the audit process, the energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for the utility operations in the auditee (Organization).

### **4.4. Energy audit observations**

During onsite audit following departments were verified for physical facility availability.

- Adequate awareness programmes are organized and conducted to the stakeholders for the proper handling and maintenance of the appliances.

- Adequate external and vertical shading are provided to conserve energy.
- Natural ventilation through windows and shading is available adequately to reduce the energy consumption.
- It is observed that large foliage trees are planted inside the campus to reduce noise pollution.
- Low emitting lights are fixed as per the LPD mentioned in National Building Code (NBC) Part -11(Approach to Sustainability) for safety and comfort.
- ‘Danger’ and ‘warning boards’ are available near transformer.
- Building Integrated Photovoltaic system like power storage system, backup power supplies, wiring and safety disconnects are available.
- Adequate HVAC and day lighting facilities are observed.
- Outside air is introduced through windows for ventilation in the conditioned spaces.
- The metering system are appropriately monitored through maintenance of log books and sub meters.
- Five star rated appliances (AC, Air cooler, Refrigerator, etc.,) are procured to conserve energy.
- All the fluorescent (tube) lights are replaced with LED lights to conserve energy.
- Awareness posters like ‘Turn off when not in use’, ‘Save Energy’, etc., are displayed for conserving energy.
- All are the artificial lighting system are monitored and controlled through partial availability of sensors.
- Operation and maintenance manual are observed in the on-site.
- No emissions and leaks are observed
- Instruments and equipment are properly calibrated and maintained.
- Noise level observed in the different location resulted in normal range.
- Adequate training and awareness programmes are conducted to the stakeholders for energy conservation.

#### **4.4.1. Lighting facilities**

Electrical lighting facilities during day time increases the energy consumption, it is observed that sufficient day lighting facilities are available through windows which in turn reduce the energy consumption bill of the Organization. Artificial lighting facilities are regularly monitored and maintained. In some areas sensor lights are implemented to save energy. External and internal signage lits are made up of recycled material with maximum light intensity. In the buildings windows head are higher to penetrate day light.



**Sufficient day lighting facilities available through windows in the Campus**

#### **4.4.2. Heat, Ventilation and Air Conditioning System (HVAC)**

To save energy in the buildings there should be a proper plan for HVAC system. In the organization it is observed that adequate natural ventilation is implemented and practices. In some places exhaust fans are used for ventilation especially in the canteen and laboratories. To reduce the heat inside the building shading patterns are maintained by planting trees in and around the campus. Solar panels are implemented at the roof top to reduce the heat and to save energy. Air conditioning are provided at specific areas.

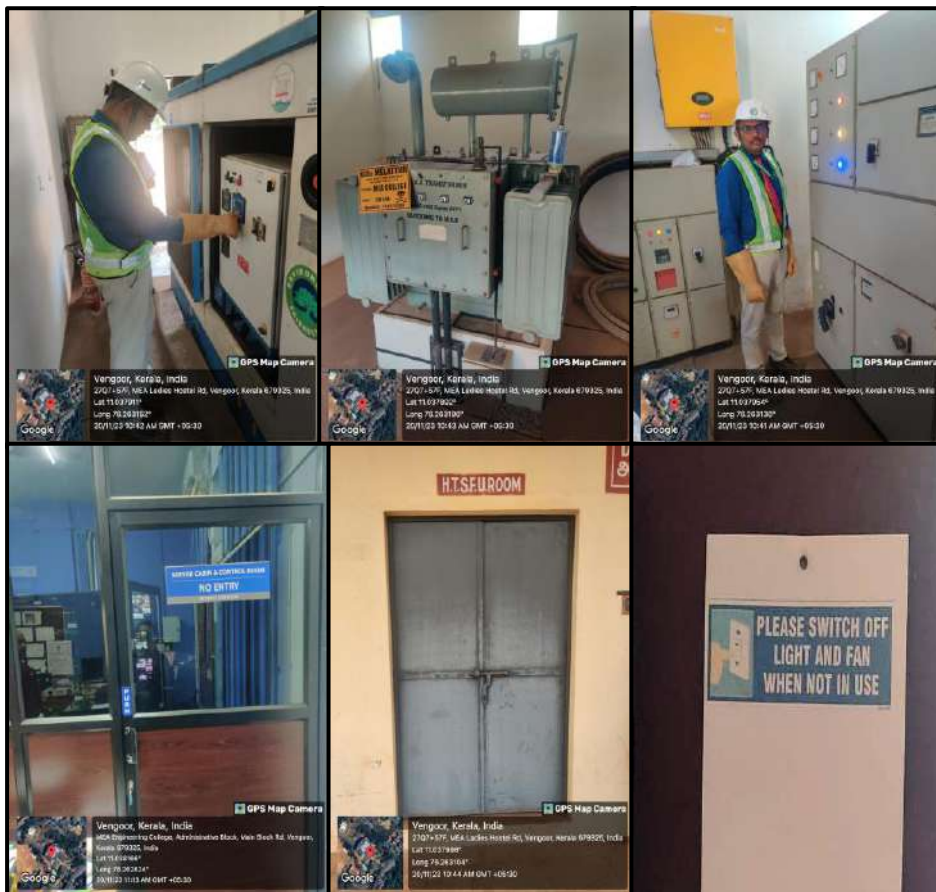


**HVAC facilities observed in the Campus**

#### **4.4.3. Steps taken to conserve energy**

Energy conservation plays an vital role in maintaining the sustainability. It is observed that the Organization has replaced all the tube light with CFL / LED lamps, has proper metering and submetering facilities, availability of BEE star rated appliances in Air cooler, lift, AC, generator, etc., Solar water heater and panels are implemented to conserve energy. Instruments and meters are properly maintained and calibrated at regular intervals or annual maintenance plan is observed as one of the energy saving opportunity. Adequate energy saving awareness programmes are conducted to the stakeholders.



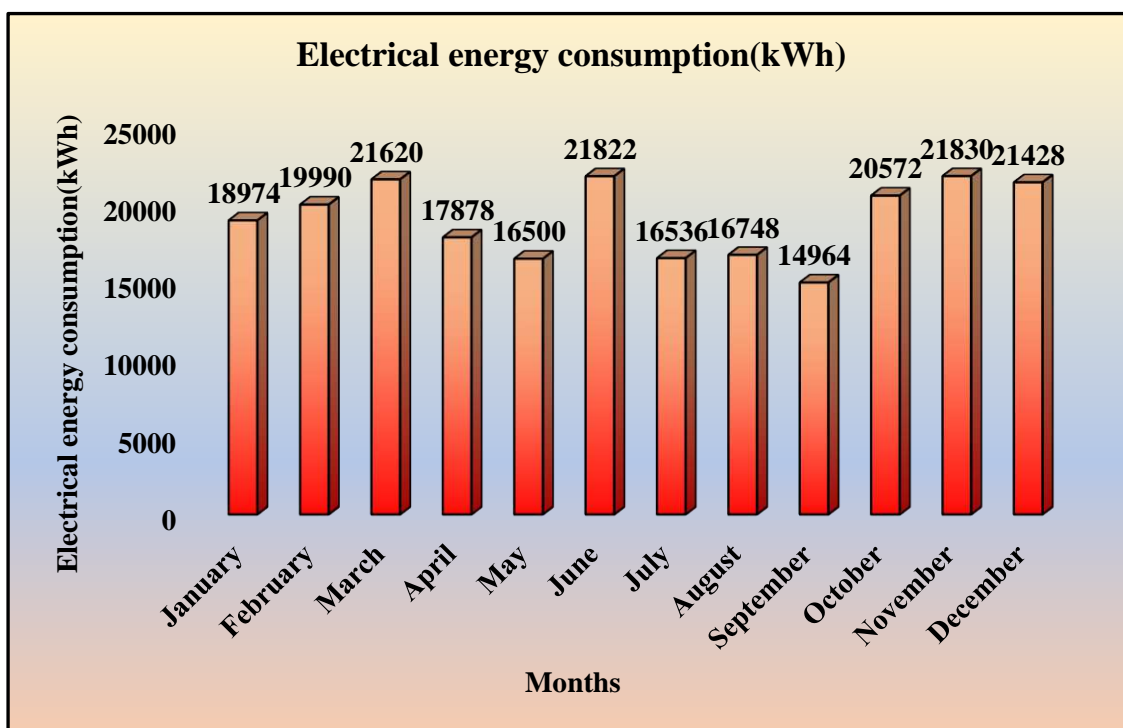


**Energy conservation facilities observed in the Campus**

**4.5. Energy consumption and cost profile**

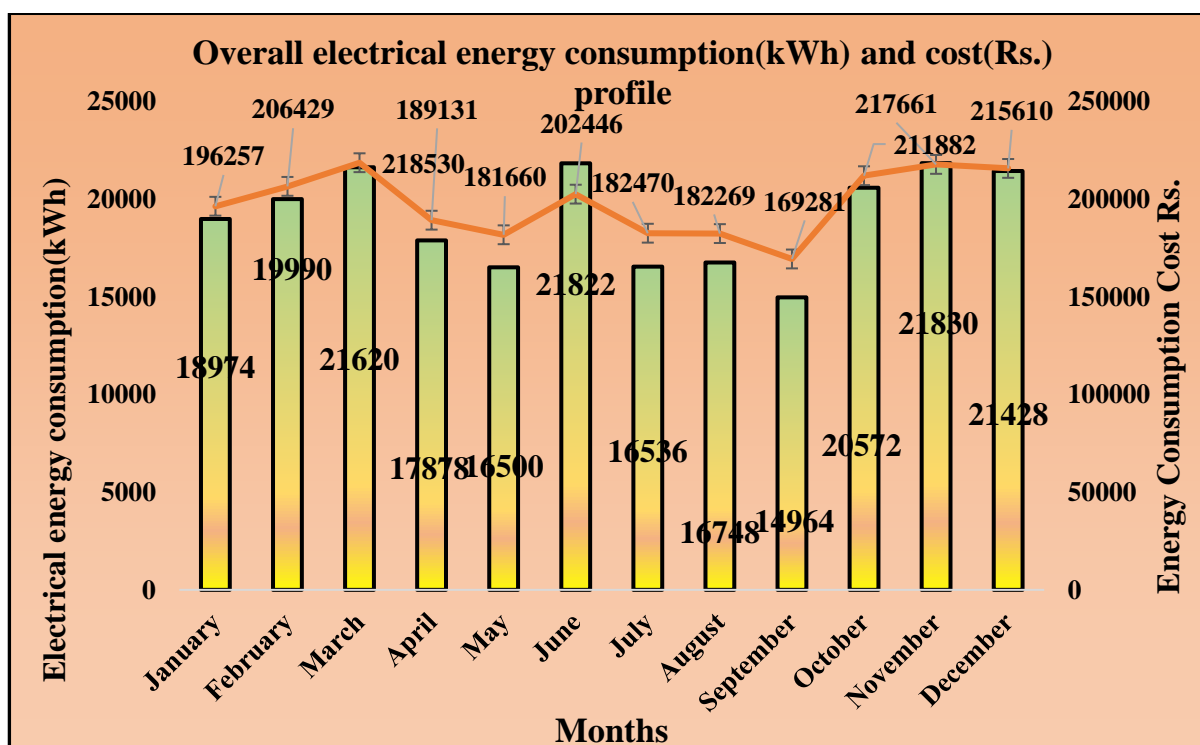
The following chart shows the profile of energy consumed and the cost for one year by the auditee (Figures 1 & 2; Table 3).

**Figure 1. Electrical energy consumption profile**



**Table 3. Electrical energy consumption and cost profile in the Institution**

S.No	Months	Rating / Capacity units in kWh	Cost in Rs.
1.	January	18974	196257
2.	February	19990	206429
3.	March	21620	218530
4.	April	17878	189131
5.	May	16500	181660
6.	June	21822	202446
7.	July	16536	182470
8.	August	16748	182269
9.	September	14964	169281
10.	October	20572	211882
11.	November	21830	217661
12.	December	21428	215610

**Figure 2. Overall electrical energy consumption and cost profile**

#### 4.6. Power consuming equipment and electrical appliances

Other than electrical energy from grid, energy generated using fossil fuels for the year 2022 are presented in the Table 4.

**Table 4. Annual Energy Consumption of Fuels in the College**

S.No	Month	Diesel consumption (Liters)	Petrol consumption (Liters)	LPG consumption (kg)
1	January	2944	25	Nil
2	February	2309	46	Nil
3	March	2641	71	Nil
4	April	2472	50	Nil
5	May	249	48	Nil
6	June	2899	46	Nil
7	July	2946	46	Nil
8	August	1482	67	Nil
9	September	1483	53	Nil
10	October	3334	78	Nil
11	November	3233	86	Nil
12	December	2960	82	Nil

#### 4.7. Carbon footprint

The carbon footprint per year is calculated ([www.carbonfootprint.com](http://www.carbonfootprint.com)) based on electricity usage per year in which CO<sub>2</sub> emission from electricity and the sum of transportation per year in terms of number of the shuttle buses service operated by the Organization and number of cars, motorcycles and trucks entering in the Organization campus. These factors are multiplied with total number of trips in each day and approximate travel distance of vehicles covered in each day with a coefficient (0.01) to calculate the emission of CO<sub>2</sub> in metric tons per year. Humans contribute to a massive increase of carbon dioxide emissions by burning fossil fuels, deforestation, and other industrial activities. Methane (CH<sub>4</sub>) is largely released by coal, oil and natural gas industries. Anthropogenic activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities is from burning fossil fuels for electricity, heat and transportation (Peters and Romi, 2014).

#### 4.8. Calculation of carbon footprint

The carbon footprint analysis can be calculated based on the earlier reports as stated in [www.carbonfootprint.com](http://www.carbonfootprint.com) which is the sum of electricity usage per year. According to the data provided by the Management, carbon emission due to electricity consumption and fossil fuels are presented hereunder.

##### The CO<sub>2</sub> emission from electricity

$$\begin{aligned}
 &= (\text{electricity usage per year in kWh}/1000) \times 0.84, \text{ where } 0.84 \text{ is the coefficient} \\
 &\text{to convert kWh to metric tons} \\
 &= (228862 \text{ kWh}/1000) \times 0.84 \\
 &= 192.24 \text{ metric tons}
 \end{aligned}$$

According to the above calculations, carbon emission due to electricity usage per year accounts for 39.7 metric tons.

**Transportation per year (Shuttle)**

$$\begin{aligned}
 &= (\text{Number of the shuttle vehicle in the campus (2)} \times \text{total trips for shuttle bus service each day} \times \text{approximate travel distance of a vehicle each day inside campus only (20 km)} \times 365/100) \times 0.01 \\
 &= ((9 \times 20 \times 1 \times 365)/100) \times 0.01 \\
 &= 6.57 \text{ metric tons}
 \end{aligned}$$

365 is the number of days per year

0.01 is the coefficient to calculate the emission in metric tons per 100 km for bus

**a. Transportation per year (Car)**

$$\begin{aligned}
 &= (\text{Number of cars entering the campus} \times 2 \times \text{approximate travel distance of a vehicle each day inside campus only (in kilometers)} \times 365/100) \times 0.02 \\
 &= ((15 \times 20 \times 1 \times 365)/100) \times 0.02 \\
 &= 21.9 \text{ metric tons}
 \end{aligned}$$

365 is the number of days per year

0.02 is the coefficient to calculate the emission in metric tons per 100 km car

**b. Transportation per year (Motorcycles)**

$$\begin{aligned}
 &= (\text{Number of motorcycles entering the campus} \times 2 \times \text{approximate travel distance of a vehicle each day inside campus only (in kilometers)} \times 365/100) \times 0.01 \\
 &= ((70 \times 20 \times 1 \times 365)/100) \times 0.01 \\
 &= 51.1 \text{ metric tons}
 \end{aligned}$$

365 is the number of days per year

0.01 is the coefficient to calculate the emission in metric tons per 100 km for motorcycles.

**c. Total Carbon emission per year**

$$\begin{aligned}
 &= \text{total emission from electricity usage} + \text{transportation (bus, car, motorcycle)} \\
 &= (192.24 + 6.57 + 21.9 + 51.1) \\
 &= 271.81 \text{ metric tons}
 \end{aligned}$$

**4.9. Noise level measurements**

Noise is all unwanted sound or set of sounds that causes annoyance or can have a health impact and noise level is measured in decibels (dB). Noise pollution is defined as consistent exposure to elevated sound levels that may cause adverse effects in humans or other living organisms. World Health Organization (WHO) has defined environmental noise (sound produced by transport, industrial activities, construction sites, public works and services, cultural, sporting, leisure activities and neighborhood) as noise from all sources with the exception of workplace noise and recognizes that noise pollution is an increasing problem. Prolonged exposure to loud noises (>75 dB (A) over eight hours a day for years) can lead to hearing loss. The body can also respond to lower noise levels. Level of noise are expected to be within 55 dB in residential areas, including institutions. Class room noise levels are supposed to be around 50 db. Sound Level Meter / Noise Thermometer are used to measure the noise level in the surroundings which converts the sound signal to an equivalent electrical signal and the

resulting sound pressure level in decibels (dB) referenced to 20  $\mu$ Pa. Noise level prescribed by Central Pollution Control Board was presented in the Table 5.

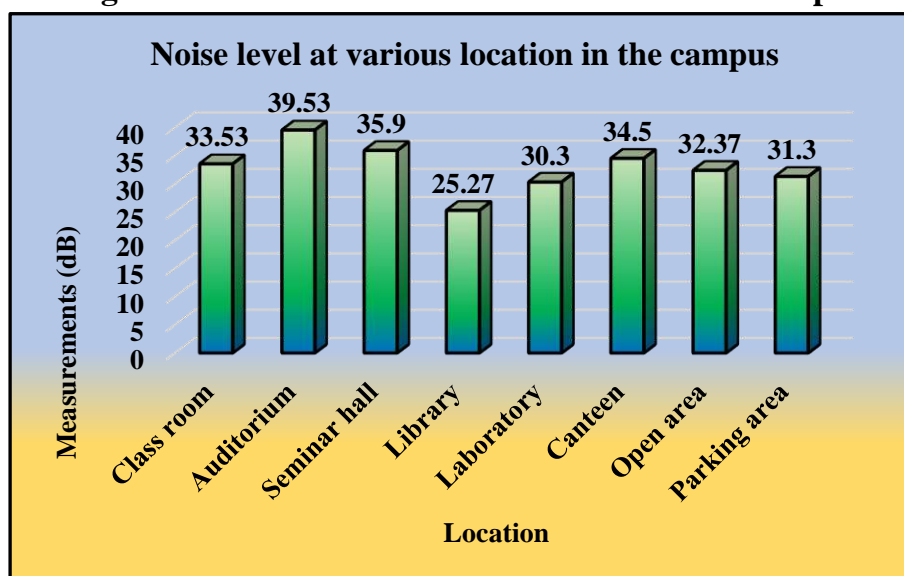
**Table 5. Noise level at various location in the campus**

S. No	Locations	Measurements (dB)	Major noise sources	Remarks
1.	Class room	33.53	Students and Staff	No Noise Pollution
2.	Auditorium	39.53	Students	No Noise Pollution
3.	Seminar hall	35.90	Students	No Noise Pollution
4.	Library	25.27	Staff members	No Noise Pollution
5.	Laboratory	30.30	Students	No Noise Pollution
6.	Canteen	34.50	Students and Staff	No Noise Pollution
7.	Open area	32.37	Students and staff	No Noise Pollution
8.	Parking area	31.30	Vehicles	No Noise Pollution
	Mean	33.29		
	SE	0.25		
	CD	0.45		

**Table 6. Noise level standard prescribed by Central Pollution Control Board, Government of India**

Area Code	Zone	Limits in dB (A) Leq	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence	50	40

**Figure 3. Noise level at various location in the campus**



Source: IS : 12065 - 1987

#### 4.10. Light intensity measurement at the campus

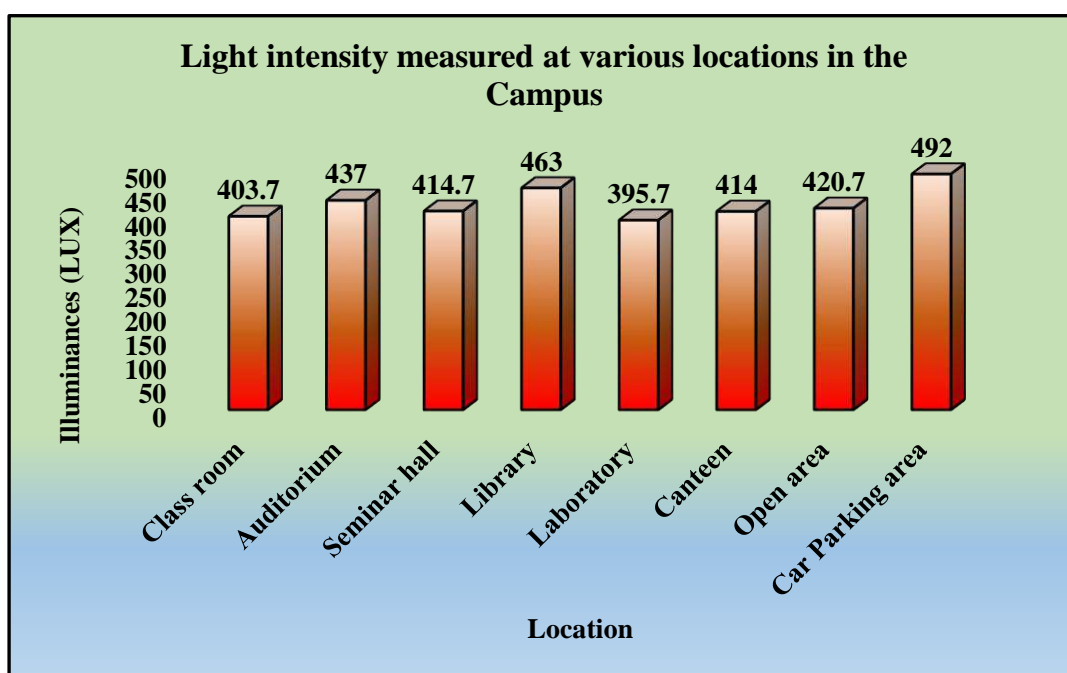
Light intensity or light output is used to measure whether a particular light source provides enough light for an application needed. There is a well-established light level recommendation for a wide range of applications in lighting industry and also for the type of space. Light intensity is measured in terms of lumens per square foot (foot-candles) or lumens per square meter (lux). A light meter (lux meter) is used to measure the amount of light in a space/on a particular work surface. The light meter consists of a sensor that measures the light falling on it and provides the user with a measurable illuminance reading. Light meters are an especially useful tool for measuring light for safety or over-illumination.

**Table 6. Light intensity measured at various locations in the Institute**

S.No	Type of Spaces	Illuminances (LUX)
1.	Class room	403.7
2.	Auditorium	437.0
3.	Seminar hall	414.7
4.	Library	463.0
5.	Laboratory	395.7
6.	Canteen	414.0
7.	Open area	420.7
8.	Car Parking area	492.0
	Mean	382.3
	SE	3.39
	CD	6.03

Source: IS: 6665-1972

**Figure 4. Light intensity measured at various locations in the Institute**



#### 4.11. Voltage Measurement at the Campus

Voltage measurement in AC & DC at different places in the campus is measured using the clamp (voltage) meter to reduce the energy consumption.

**Table 7. Voltage measured at various locations in the Institute**

S.No	Name of the Place	AC & DC Voltage Measurement [Volt (v)]
1.	Class Room (AC)	237.0
2.	Auditorium (AC)	241.7
3.	Seminar Hall (AC)	237.0
4.	Library (AC)	239.0
5.	Laboratory (AC)	239.7
6.	Canteen (AC)	239.3
7.	Power Room (AC)	240.0
8.	Generator Area (AC)	240.0

**Source:** BEE, 2015, Bureau of Energy Efficiency



### Analyses of Noise level, Light intensity and Voltage intensity in the campus

#### 4.12. Conclusion

Considering the fact that the organization is a well-established, there is significant scope for conserving energy, water and make the campus as self-sustained in it. The energy conservation initiatives taken up by the organization are substantial. Water conservation activities are also implemented and practiced. Proper facilities and procedures are followed for waste collection, segregation, disposal, recycle and reuse. Quality of soil and water observed to be good. Hygienic practices are monitored and maintained considering the health and sustainability of the stakeholders. Tree Plantation at appropriate locations are maintained to resist the indoor climate and conserve energy as per the National Building Code (Part 11 – Approach to Sustainability).

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2. ISO Certificate (EMS 14001:2015)
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Partha Bagchi  
(Managing Director)

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1<sup>st</sup> Surveillance Audit Due: 8th August 2023

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## BUREAU OF ENERGY EFFICIENCY



Examination Registration No. : **EA-14056** Serial Number **9176**

Certificate Registration No. : **9176**

### Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. **Dinesh Kumar D** Son/Daughter of Mr./Mrs. **R M Dhanasekaran** who has passed the National Examination for certification of energy manager held in the month of **October 2011** is qualified as certified energy manager subject to the provisions of Bureau of Energy Efficiency (Certification Procedures for Energy Managers) Regulations, 2010.

This certificate shall be valid for five years with effect from the date of award of this certificate and shall be renewable subject to attending the prescribed refresher training course once in every five years.

His /Her name has been entered in the Register of certified energy manager at Serial Number **9176** being maintained by the Bureau of Energy Efficiency under the aforesaid regulations.

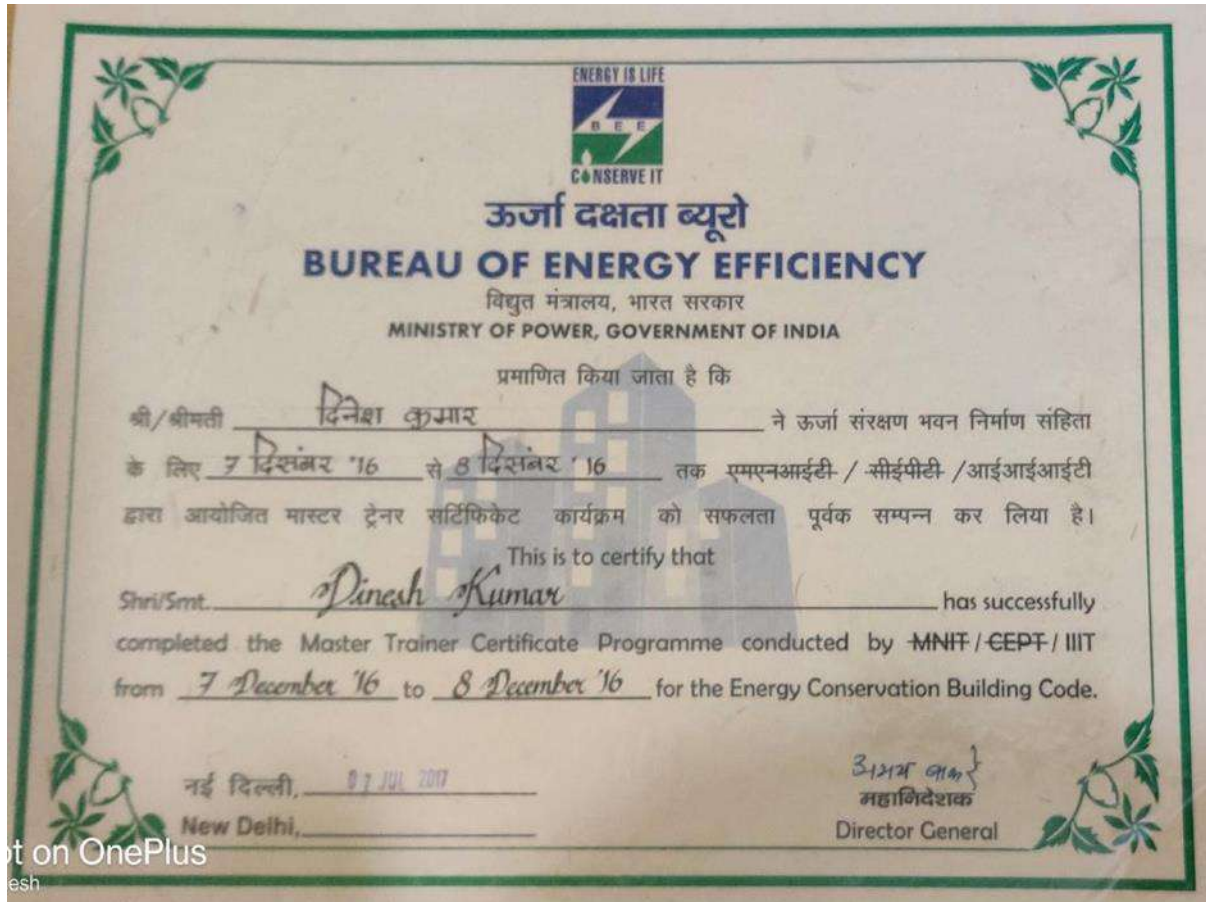
Mr./Mrs./Ms. **Dinesh Kumar D** is deemed to have qualified for appointment or designation as energy manager under clause (i) of Section 14 of the Energy Conservation Act, 2001 (Act No.52 of 2001).

Given under the seal of the Bureau of Energy Efficiency, this **7<sup>th</sup>** day of **February, 2013**

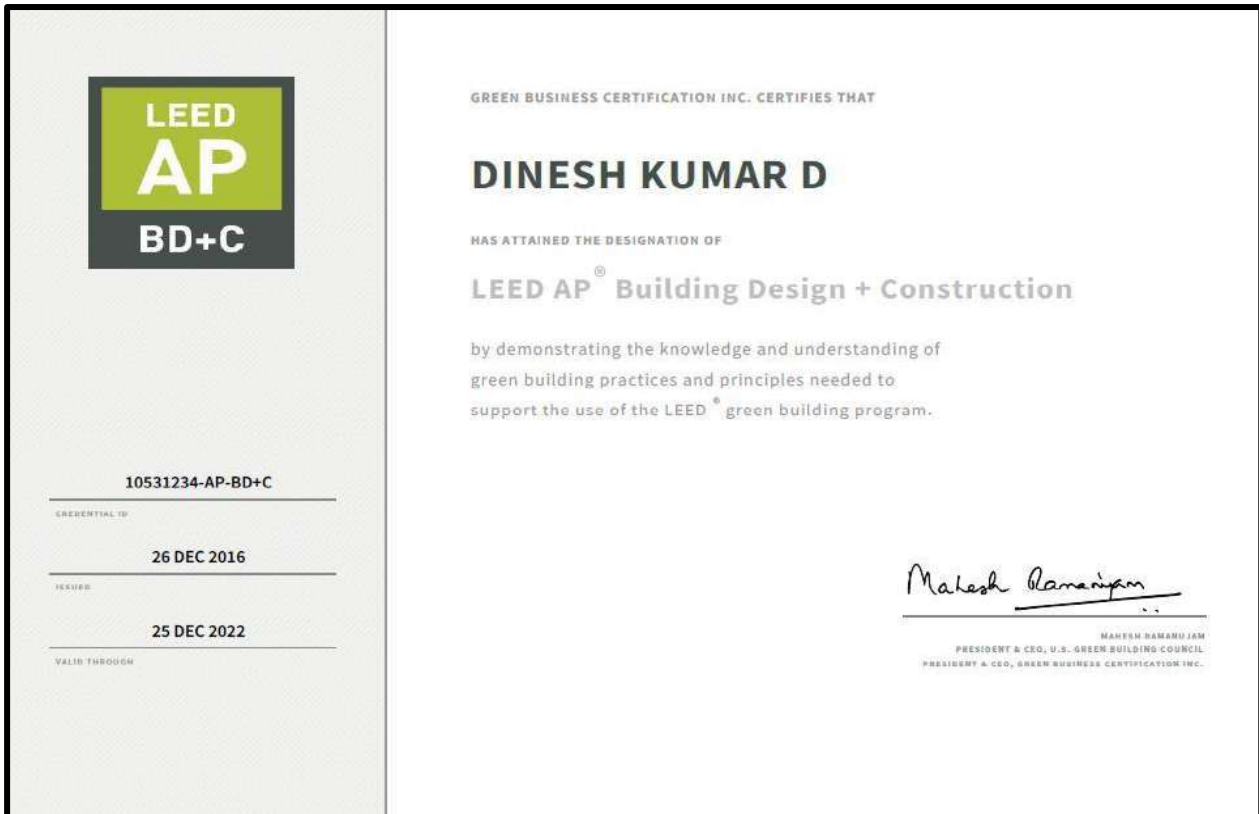
Secretary  
Bureau of Energy Efficiency  
New Delhi

Digitally Signed: RAKESH KUMAR RAI  
Sun Mar 01 10:58:55 IST 2020  
Secretary, BEE New Delhi

Dates of attending the refresher course	Secretary's Signature	Dates of attending the refresher course	Secretary's Signature
<b>22.12.2019</b>			









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*This is to certify that*

**DR. D. VINOOTH KUMAR**

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**ENERGY MANAGEMENT SYSTEMS**

Examination Date: 15/07/2022

Certificate issue Date: 22/07/2022

Certificate registration number: QCS/TR/C/0056

Total Course duration: 40 hours CPD Credits Earned: 32

Remarks: Roughly one hour of study time equals to 1 CPD Credit.

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**Partha Bagchi**  
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