Report No: NSF/F/47 File No: 116

Report of Air Quality, Carbon, Environment, Energy, Fire Safety, Green, Hygiene, Soil, Water and Waste Management Audits

Submitted to

ST. XAVIER'S COLLEGE (AUTONOMOUS)
Palayamkottai - 627 002
Tamil Nadu, India

Date of Audit : 30.03.2026
Date of Issue :
Date of Validity : 29.03.2028

Regd. No. 114 / 2017

IB 121

Submitted by

NATURE SCIENCE FOUNDATION

[ISO/IEC 17020:2012 and ISO/IEC 17021:2015 Accredited Inspection (Reg. No. IB 121) and Certification (Reg. No. QM 097) Bodies by National Accreditation Board for Certification Bodies, QCI, Govt. of India]

No. 2669, LIG-II, Gandhi Managar, Peelamedu
Coimbatore - 641 004, Tamil Nadu, India.
Phone: 0422 4917999, Mobile: 9566777255, 9566777258
Email: director@nsfonline.org.in, Website : www.nsfonline.org.in

Report of Air Quality, Carbon, Environment, Energy, Fire Safety, Green, Hygiene, Soil, Water and Waste Management Audits

Submitted to

ST. XAVIER'S COLLEGE (AUTONOMOUS), Palayamkottai - 627 002 Tamil Nadu, India

Cross Reference & Traceability - File No: 116

- **Checklist No: NSF/F/45**
- **Certificate No: NSF/F/46**
- **Report No: NSF/F/47**
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Regd. No. 114/2017

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0422 4917999 95667 77255, 95667 77258 director@nsfonline.org.in www.nsfonline.org.in

Dr. S. RAJALAKSHMI, M.B.A., Ph.D., FNSF.
Chairperson

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 **St. Xavier's College (Autonomous), Palayamkottai - 627 002, Tamil Nadu, 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.
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.
7. Reports and Certificates are valid till 29.03.2028

Date: 30.03.2026
Place: Coimbatore

Authorized Signatory
Nature Science Foundation

Signature of the Director
NSF Audit Processes

National Accreditation Board for Certification Bodies

Accreditation Certificate

NABCB

hereby confirms that

Nature Science Foundation

No. 2669, LIG-II,Gandhi Managar,
Peelamedu, Coimbatore – 641004,
Tamil Nadu, India

complies with

NABCB Accreditation Criteria for Inspection Bodies

(ISO/IEC 17020:2012)
as Type 'A' Inspection Body

to carry out

Inspection

as per accompanying

Schedule I : Scope of Accreditation
Schedule II : Office(s) under Accreditation

Accreditation Certificate No.:		**IB 121**
Date of Initial Accreditation	:	January 10,2024
Validity of Accreditation	:	January 09, 2027

January 10, 2024
Issue Date

(RajeshMaheshwari)
Chief Executive Officer

(Please refer **http://nabcb.qci.org.in** for validity of the certificate or contact NABCB for any related queries)

National Accreditation Board for Certification Bodies

Schedule I

(Scope of Accreditation)

Nature Science Foundation

Type 'A' Inspection Body

IAF Scope / Field of Inspection and Specific Item(s)	Stage and Range of Inspection(s)	Inspection Requirement(s) Standards / Regulations / Methods / Procedures	
		Number identification with year of publication	Title
IAF Scope 28 Buildings and Associated Infrastructure Green Audit	Green audit of educational institutions as per NBC2016 Part 11	NBC 2016 (Part-11) 14-29/2022 dated 26.05.2022	National Building Code Part 11: Approach to Sustainability NAAC Advisory Client Requirements in the form of QAP mentioning required specification and scope mentioned in this scope. However, the applicable National & International Codes and Standards shall be among those which are either referred in the scope statement or shall be equivalent to the standards described above for the relevant scope category

January 10, 2024
Issue Date

(Rajesh Maheshwari)
Chief Executive Officer

(The schedule must be accompanied by the Accreditation Certificate No. **IB 121** valid upto January 09, 2027)

National Accreditation Board for Certification Bodies

Schedule II

(Office(s) under Accreditation)

Nature Science Foundation

Location	Address	Key activities performed
Coimbatore Tamil Nadu (Main Office)	No. 2669, LIG-II, Gandhi Managar, Peelamedu, Coimbatore – 641004, Tamil Nadu, India	Top Management functions, Quality Management System functions, administration & accounts, other key activities. Inspection contract review, Inspection planning & execution, Inspection personnel authorization & assignment, Issue of inspection reports / certificates.

January 10, 2024
Issue Date

(Rajesh Maheshwari)
Chief Executive Officer

(The schedule must be accompanied by the Accreditation Certificate No. **IB 121** valid upto 09 January 2027)

NATURE SCIENCE FOUNDATION

[A Unique Research and Development Centre for Society Improvement]
ISO/IEC 17020:2012 and ISO/IEC 17021:2015 Accredited Inspection
(Reg. No.: IB 121) and Certification (Reg. No.: QM 097) Bodies
by NABCB, QCI, Government of India.

Regd. No. 114/2017

Inspection Certificate

This is to certify that the St. Xavier's College (Autonomous), Palayamkottai, Tirunelveli – 627 002, Tamil Nadu, India has implemented ecofriendly sustainability practices in line with National Building Code of India, Part - 11: Approach to Sustainability parameters which covers the following areas,

1. Air Quality Audit
2. Carbon Audit
3. Environment Audit
4. Energy Audit
5. Fire Safety Audit
6. Green Audit
7. Hygiene Audit
8. Soil Audit
9. Water Audit
10. Waste Management Audit

NABCB
IB 121

ilac-MRA

Date of Inspection: 30.03.2026
Date of Issue: 30.03.2026
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Cross Reference & Traceability - File No: 116
Checklist No: NSF/F/45
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Dr. D. Vinoth Kumar
Director (Audits)

Dr. S. Rajalakshmi
Chairperson

No. 2669, LIG-II, Gandhi Managar, Peelamedu, Coimbatore - 641 004, Tamil Nadu, India.
Phone: 0422 4917999; Mobile: 95667 77255; 95667 77258
Email: director@nsfonline.org.in, Website: www.nsfonline.org.in

CONTENTS

1. INTRODUCTION OF GREEN & ENVIRONMENT SUSTAINABILITY AUDITS

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_2 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. 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, Part-II: Approach to Sustainability

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 offering 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. 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 members and faculty of different discipline 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 & OccupationalSafety & Health (FSMS), Swatch 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.

Introduction of National Building Code, Part - II: Approach to Sustainability in the construction industry, building commercial and residential properties used a lot of energy which adversely affected the sustainable environment with reference to the various types of hazards which in turn required to save the 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 the various types of safety measures are the primary objective, new as well as old building codes are making significant contributions toward solving chemical, biological, noise, radiation and fire hazardous related issues connecting to the use of environmentally compatible

construction techniques. Environment sustainability audits are a type of tool for assessing the Green, Environment, Energy, Air Quality, Hygiene, Fire Safety, Soil, Water and Waste Management of an organization which examines the organization's ecosystem of daily operations and recommends measures to reduce potential of risks.

1.4. About Nature Science Foundation (NSF)

Nature Science Foundation (NSF), Coimbatore, Tamil Nadu, India is functioning energetically to conduct different awareness programmes and implement various schemes to public and School / College / University students towards the noble cause of nature conservation and environmental protection. NSF is a Non-Governmental Organization registered under the TN Societies Registration Act 1975 (TN Act 27 of 1975) on 29th November 2017 at Coimbatore, Tamil Nadu, India. This organization is the ISO/IEC 17020:2012 accredited 'Inspection Body (Reg. No.: IB 121)' as well as ISO/IEC 17021:2015 accredited 'Certification Body (Reg. No.: QM 097)' by National Accreditation Board for Certification Bodies (NABCB), Quality Council of India (QCI), Government of India to conduct various types of green, environment and energy audits along with ISO Quality Management System (ISO 9001:2015) and Educational Organization Management System (ISO 21001:2018) audits at educational institutions, industries and public sectors. In order to maintain the quality of educational institutions across the world, various type of audits and certifications are being implemented in accordance with ISO standards.

With over 250+ successful audits across the world as on date. A large number of audits have been conducted from Kashmir to Kanyakumari including union territory of Ladakh in pan India. NSF has 154 empaneled Lead Auditors and 55 Technical Experts to execute high-quality, transparent and ethical audits that ensure learner-focused assessments. Choosing NSF ensures compliance, credibility and continual improvement for educational excellence by the faculty members and teachers is noteworthy towards the environmental susceptibility. NSF has been granted the 12A, 80G and Form 10AC certificates for Government funding and recognitions. NSF has been recognized for excellence across the education sector with national and international reputation. Highly experienced team of Certified Lead Auditors, Academic Experts and Technical Professionals are the noteworthy features of NSF for conducting green and ISO audits in pan India and abroad, besides, adds the credibility for CSR funding, R&D proposals and industry MoUs for academic and business collaboration for sustainable environment.

As per the NAAC circular (F.No.14-29/2022 dated 26th May 2022), it is advised that in case of any educational institution goes for green audit, it should ensure that the agency is accredited as per ISO/IEC 17020:2012 for a recognized standard / criteria for green audits by NABCB or any member of ILAC and the report / certificate carries the logo of AB. These criteria are satisfied by the NSF and a signatory to the ILAC Mutual Recognition Arrangement (ILAC MRA) and NABCB-IAF, Quality Council of India, Government of India. Green, Environment, Energy, Hygiene, Waste Management, Air quality, Soil, Water, Biodiversity, Fire & Life Safety Audits are introduced for the benefit of NAAC and NBA accreditation including National (NIRF) and World ranking frameworks. Based on the checklists prepared as per the 'National Building Code, Part-

11: Approach to Sustainability parameters and ISO QMS 9001:2015, EMS 14001:2015, ISO EnMS 50001:2018 and ISO/IEC 17020:2012 standards in line with NABCB guidelines, audit processes are being carried out. Audit certificates and reports will be given after visiting the campus by a team of certified Lead Auditors and empaneled Technical Experts from NSF.

1.5. About the Organization

St. Xavier's College (Autonomous), Palayamkottai

St. Xavier's College (Autonomous), Palayamkottai, is a prestigious arts and science college established in the year 1923 by the Jesuit Fathers with the aim of providing quality higher education, especially to the marginalized and rural youth of the southern districts of Tamil Nadu. The institution functions with the motto "Veritate Lumen et Vita" which means "Light and Life through Truth".

Since its establishment, the college has grown into one of the leading higher educational institutions in Tamil Nadu, offering undergraduate, postgraduate and doctoral programmes in Arts, Science, Commerce, Management and Computer Applications. The college is an autonomous institution affiliated to Manonmaniam Sundaranar University, Tirunelveli and recognized by the University Grants Commission (UGC).

The college was recognized as a First Grade College by the University of Madras in 1925 due to its academic excellence. Later, it became affiliated to Madurai Kamaraj University in 1966 and then to Manonmaniam Sundaranar University in 1990. The institution was granted autonomous status in 1987 in recognition of its academic achievements and service to society.

The campus is spread over a large green area and provides a peaceful academic environment with well-equipped laboratories, libraries, hostels, sports facilities and modern infrastructure. The college focuses not only on academic excellence but also on character formation, discipline, social responsibility and holistic development of students.

Over the years, St. Xavier's College has produced many distinguished alumni who have contributed significantly in the fields of education, politics, science, arts and public service. The institution continues to uphold its tradition of academic excellence, value-based education and service to society.

1.6. Audit Team Details

1.	**Date of Audit**	: **30.03.2026**
2.	**Audit Site**	: **St. Xavier's college (Autonomous),** Palayamkottai - 627 002, Tamil Nadu, India
3.	**Inspection Body**	: **Nature Science Foundation** Coimbatore, Tamil Nadu, India.
4.	**Audit Scope**	: **Air quality, Carbon, Environment, Energy, Fire safety, Green, Hygiene, Soil, Water and Waste Management Audits as per ISO/IEC 17020:2012 standards in line with NBC Part-II parameters**
5.	**Name of the Auditing Chairman**	: **Dr. S. Rajalakshmi** ISO QMS, EMS and EnMS Certified Lead Auditor ISO 17020:2012 (Green Audit) Founder & Chairperson of NSF.
6.	**Name of the Quality Manager & Joint Director**	: **Mrs. V. Sri Santhya** ISO QMS, EMS and EnMS Certified Lead Auditor ISO 17020:2012 (Green Audit) & ISO 17021:2015 (ISO Certification Audit) Quality Manager & Joint Director of NSF
7.	**Name of the Auditing Team Leader & Lead Auditor for Soil Audit + Water Audit + Hygiene Audit + Waste Management Audit**	: **Dr. D. Vinoth Kumar** ISO QMS, EMS and EnMS Certified Lead Auditor & ISO 17020:2012 (Green Audit) Director & Technical Manager, NSF.
8.	**Name of the Lead Auditor for Green Audit + Environment Audit + Air Quality Audit**	: **Er. C. Anandha Kumar** ISO QMS, EMS and EnMS Certified Lead Auditor
9.	**Name of the Lead Auditor for Fire Safety + Carbon + Energy Audit**	: **Er. A. Karthik** Bureau of Energy Efficiency Certified Auditor.
10.	**List of Auditees**	: **1. Rev. Fr. Dr. Godwin Rufus, S.J,** Principal **2. Dr. A. Lowrdusamy,** Deputy Principal **3. Dr. R. Azhaguraj,** IQAC Director **4. Dr. S. Athisayanathan,** COE **5. Dr. M. Johnson Gritto,** Assistant Professor **6. Dr. R. Geetha,** Dean of Science

1.7. Audit Scope and Criteria

Green audits are conducted in line with National Building Code (NBC), Part - 11: Approach to Sustainability parameters as per the NAAC advisory circular, NABCB guidelines and ISO/IEC 17020:2012 standards. NBC Part 11 consists of 11 different types of clauses. In this report the eleven clauses of sustainability are differentiated into Air Quality, Carbon, Environment, Energy, Fire Safety, Green, Hygiene, Soil, Water and Waste Management audits.

S.No.	Name of the Audits	NBC covered clauses
1.	Air Quality Audit	8. Envelope Optimization (8.1 & 8.2), 9. Materials (9.1 & 9.2), 10. Water and Waste Management (10.1 & 10.6) 11. Building service Optimization (11.3, 11.4, 11.5 & 11.6), 12. Construction Practices (12.4.3.)
2.	Carbon Audit	6. Siting, Form and Design (6.2.10), 7. External Development and Landscape (7.1.1 & 7.1.2), 9. Materials (9.2.1.2, 9.2.2.2 & 9.2.1.7), 10. Water and Waste Management (10.6.3), 11. Building service Optimization (11.6, 11.8 & 11.9),
3.	Environment Audit	3. Approach to Sustainability (3.2, 3.7, 3.10 & 3.11), 4. Applicability of this part (4.1 & 4.2), 5. Implementation of this part (5), 6. Siting, Form and Design (6.2.1.), 7. External Development and Landscape (7.1.2 & 7.2-7.4.), 9. Materials (9.1-9.3), 10. Water and Waste Management (10.1.), 12. Construction Practices (12.8 & 12.11)
4.	Energy Audit	3. Approach to Sustainability (3.2, 3.5, 3.6 & 3.8), 6. Siting, Form and Design (6.2.2, 6.2.3, 6.2.5, 6.2.6, 6.2.7, 6.2.8, 6.2.9 & 6.2.10), 7. External Development and Landscape (7.5), 8. Envelope Optimization (8.1, 8.2 & 8.3), 11. Building service Optimization (11.1 – 11.16), 12. Constructional Practices (12.3.4, 12.4.4 & 12.9.), 13. Commissioning, Operation, Maintenance and Building Performance Tracking (13.1, 13.2, 13.3, 13.4, 13.5 & 13.6.)
5.	Fire Safety Audit	3. Approach to Sustainability (3.11 & 3.12) 9. Materials (9.2. 9.5 & 9.6) 10 Water and Waste Management (10.2 & 10.6) 11 Building Services Optimization (11.4)
6.	Green Audit	3. Approach to Sustainability (3.2 & 3.9), 6. Siting, Form and Design (6.2.4.), 7. External Development and Landscape (7.1.1), 12. Constructional Practices (12.4.5 & 12.4.6.)
7.	Hygiene Audit	6. Siting, Form and Design (6.2.2-6.2.10), 9. Materials (9.2 & 9.5)

		10. Water and Waste Management (10.3), 11. Building service Optimization (11 &10.3.3), 12. Construction Practices (12.3.5, 12.3.6, 12.3.7 & 12.8)
8.	Soil Audit	9. Materials (9.2. 9.5 & 9.6) 7. External Development and Landscape (7.5.), 8. Envelope Optimization (8.1, 8.2 & 8.3), 12. Construction Practices (12.4.1 & 12.4.2.)
9.	Water Audit	7. External Development and Landscape (7.3.2), 10. Water and Waste Management (10.2. – 10.5.), 12. Construction Practices (12.4.1 & 12.4.2.)
10.	Waste Management Audit	3. Approach to Sustainability (3.3 & 3.4), 10. Water and Waste Management (10.6.1 – 10.6.5.), 12. Construction Practices (12.1 - 12.3, 12.5, 12.7 & 12.10.)

1.8. Audit Checklist Observations

The audit checklist in line with National Building Code (NBC), Part - 11: Approach to Sustainability parameters covers 163 checkpoints. During the onsite visit, respective auditors marks not applicable and write the reason for non-applicability and wherever its applicable, auditors verifies the records / practice / documents and physical observation to confirm the same.

There are two parameters such as meeting the requirements and not meeting the requirements. Marking as meeting the requirements for the specific checkpoint reveals that the physical observation and documents are up to the mark. For some checkpoints OFI – Opportunity for Improvements will be given by the auditors. The physical observations and documents which are not up to the mark will be given as not meeting the requirements. The checkpoints under not meeting the requirements are up to the Management of the Organization to develop further.

1.9. 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 (JRTS 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.

1.9.1. 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_2, resolution of 0.1%, accuracy is ± (1% reading + 0.2% O_2), response time is ≤ 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.

1.9.2. 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_2 Meter is 1 ppm, accuracy is ≤ 1,000 ppm, repeatability is ± 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.

1.9.3. Light (LUX) Meter

Light meter is to calculate the light intensity in the organization. Suitability of the instruments are, 5 ranges. ie., 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.

1.9.4. 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±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.

1.9.5. 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 ± 2%, resolution of the instrument is 0.1 pH, operating temperature is 0 to 50 °C (32 to 122 °F).

1.9.6. 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 ± 2 %. This meter is calibrated six months once or 20 times after its use.

1.9.7. Air Quality Index (AQI) Meter

An AQI meter measures air pollution levels by tracking pollutants like PM2.5, PM10, nitrogen dioxide, sulfur dioxide, carbon monoxide, and ozone. The AQI scale ranges from 0 to 500, where lower numbers indicate cleaner air and higher numbers signify increasing pollution levels. This meter is calibrated six months once or 20 times after its use.

1.9.8. Deluxe Water and Soil Analysis Kit

Deluxe water and soil analysis kit is used to analyze the pH, TDS, salinity, turbidity, alkalinity and dissolved oxygen of water. Similarly, soil parameters like soil pH, total organic carbon, nitrogen, potassium and phosphorus are being estimated. The water quality and soil health parameters are being analyzed.

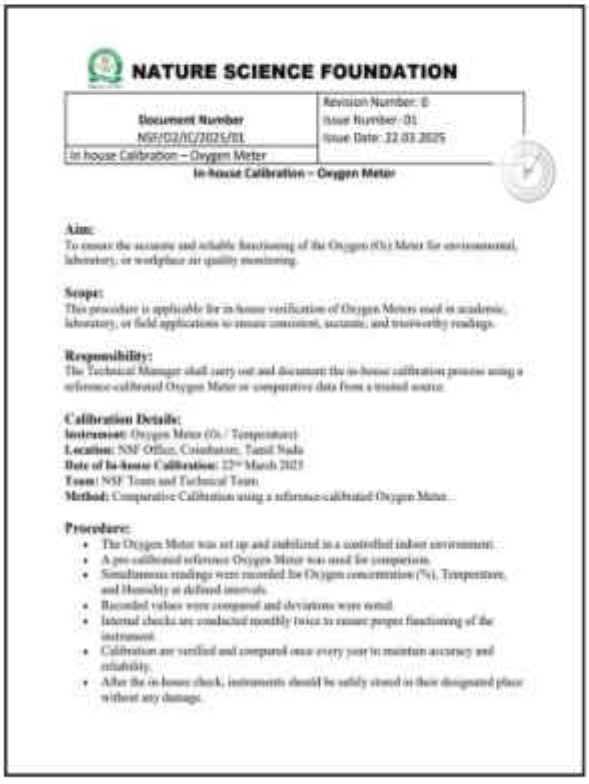
1.9.9. Digital Clamp (Voltage) Meter

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. It is measured by connecting the device in series within the circuit, ensuring all current passes through it.

1.9.10. Instruments calibration procedure

Instruments are calibrated before the inspection activity. Calibration are being done after every 30 uses of the instrument and the calibration certificates are maintained at NSF office which is traceable to National and International Standard of Measurements. Instruments used are subjected to in-service checks between regular recalibrations. Since all the instruments are calibrated at NABL accredited / reputed laboratory (subcontractor), keeping Customer Relationship Management (CRM) at NSF office is not applicable. The NSF has documented procedures (standard operating procedures) for all the instruments which are used for inspections.

1.9.10. Calibration Certificates of Instruments used for the conduct of audits



NATURE SCIENCE FOUNDATION

Document Number	Revision Number: 0
NSF/O2/IC/2025/01	Issue Number: 01
In house Calibration – Oxygen Meter	Issue Date: 22.03.2025

In-house Calibration – Oxygen Meter

Aim:
To ensure the accurate and reliable functioning of the Oxygen (O_2) Meter for environmental, laboratory, or workplace air quality monitoring.

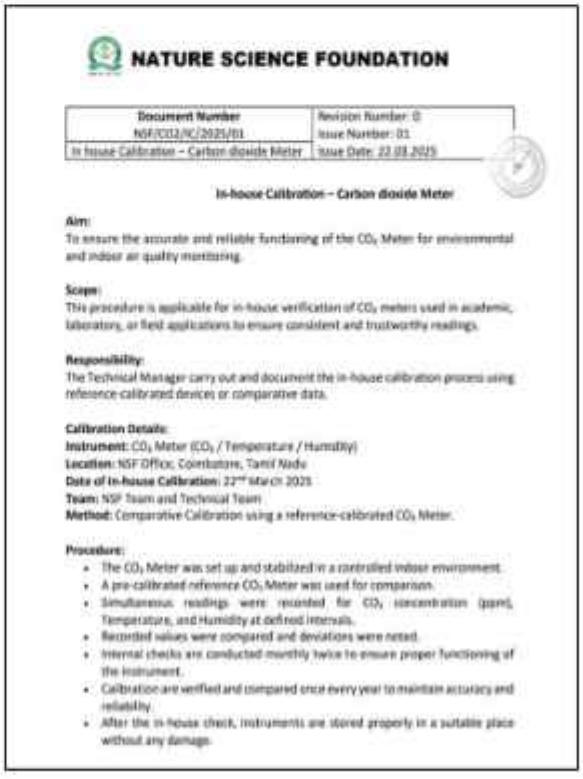
Scope:
This procedure is applicable for in-house verification of Oxygen Meters used in academic, laboratory, or field applications to ensure consistent, accurate, and trustworthy readings.

Responsibility:
The Technical Manager shall carry out and document the in-house calibration process using a reference-calibrated Oxygen Meter or comparative data from a trusted source.

Calibration Details:
Instrument: Oxygen Meter (O_2 / Temperature)
Location: NSF Office, Coimbatore, Tamil Nadu
Date of In-house Calibration: 22nd March 2025
Team: NSF Team and Technical Team
Method: Comparative Calibration using a reference-calibrated Oxygen Meter.

Procedure:
- The Oxygen Meter was set up and stabilized in a controlled indoor environment.
- A pre-calibrated reference Oxygen Meter was used for comparison.
- Simultaneous readings were recorded for Oxygen concentration (%), Temperature, and Humidity at defined intervals.
- Recorded values were compared and deviations were noted.
- Internal checks are conducted monthly twice to ensure proper functioning of the instrument.
- Calibration are verified and compared once every year to maintain accuracy and reliability.
- After the in-house check, instruments should be safely stored in their designated place without any damage.

Calibration Certificate of O_2 Meter



NATURE SCIENCE FOUNDATION

Document Number	Revision Number: 0
NSF/CO2/IC/2025/01	Issue Number: 01
In house Calibration – Carbon dioxide Meter	Issue Date: 22.03.2025

In-house Calibration – Carbon dioxide Meter

Aim:
To ensure the accurate and reliable functioning of the CO_2 Meter for environmental and indoor air quality monitoring.

Scope:
This procedure is applicable for in-house verification of CO_2 meters used in academic, laboratory, or field applications to ensure consistent and trustworthy readings.

Responsibility:
The Technical Manager carry out and document the in-house calibration process using reference-calibrated devices or comparative data.

Calibration Details:
Instrument: CO_2 Meter (CO_2 / Temperature / Humidity)
Location: NSF Office, Coimbatore, Tamil Nadu
Date of In-house Calibration: 22nd March 2025
Team: NSF Team and Technical Team
Method: Comparative Calibration using a reference-calibrated CO_2 Meter.

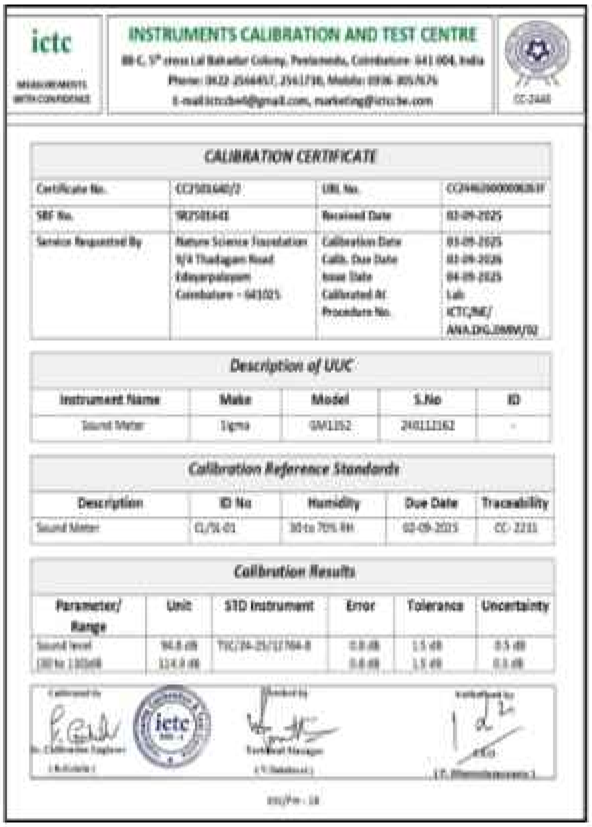
Procedure:
- The CO_2 Meter was set up and stabilized in a controlled indoor environment.
- A pre-calibrated reference CO_2 Meter was used for comparison.
- Simultaneous readings were recorded for CO_2 concentration (ppm), Temperature, and Humidity at defined intervals.
- Recorded values were compared and deviations were noted.
- Internal checks are conducted monthly twice to ensure proper functioning of the instrument.
- Calibration are verified and compared once every year to maintain accuracy and reliability.
- After the in-house check, instruments are stored properly in a suitable place without any damage.

Calibration Certificate of CO_2 Meter

INSTRUMENTS CALIBRATION AND TEST CENTRE

CALIBRATION CERTIFICATE

Calibration Certificate of LUX Meter



ictc

MEASUREMENTS WITH CONFIDENCE

INSTRUMENTS CALIBRATION AND TEST CENTRE

CC-2440

CALIBRATION CERTIFICATE

Certificate No.	CC2503440/2	ULR No.	[illegible]
SRF No.	SR2503441	Received Date	02-09-2025
Service Requested By	Nature Science Foundation 9/4 Thadagam Road Edayarpalayam Coimbatore – 641025	Calibration Date Calib. Due Date Issue Date Calibrated At Procedure No.	03-09-2025 02-09-2026 04-09-2025 Lab ICTC/NE/ANA.DIG.[illegible]

Description of UUC

Instrument Name	Make	Model	S.No	ID
Sound Meter	Sigma	SM1352	241112162	-

Calibration Reference Standards

Description	ID No	Humidity	Due Date	Traceability
Sound Meter	CL/SL-01	30 to 70% RH	02-09-2025	CC-2231

Calibration Results

Parameter/ Range	Unit	STD Instrument	Error	Tolerance	Uncertainty
Sound level [illegible]	94.0 dB 114.0 dB	TIC/24-25/12764-8	0.0 dB 0.0 dB	1.5 dB 1.5 dB	0.5 dB 0.5 dB

Calibrated by — Sr. Calibration Engineer

Checked by — Technical Manager

Authorised by — CEO

Calibration Certificate of Sound Level Meter

INSTRUMENTS CALIBRATION AND TEST CENTRE

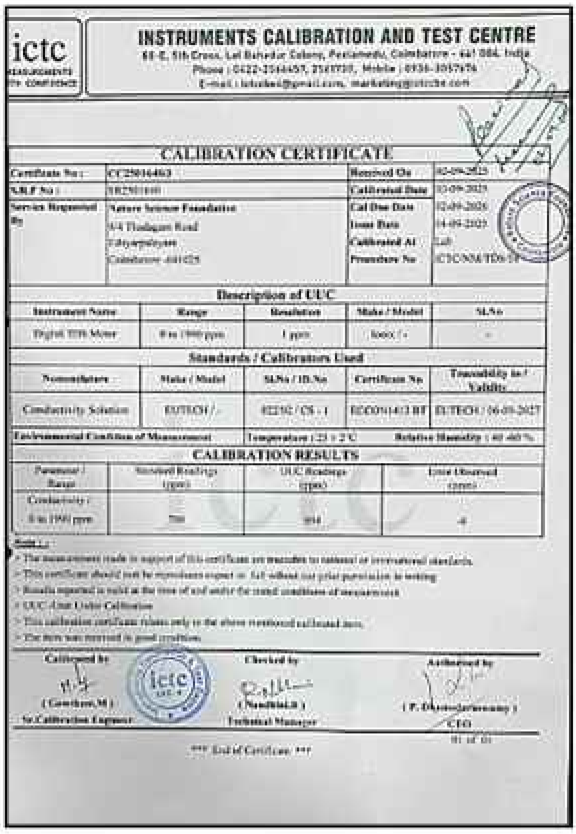
CALIBRATION CERTIFICATE

Description of UUC

Standards / Calibrators Used

CALIBRATION RESULTS

Calibration Certificate of pH Meter



INSTRUMENTS CALIBRATION AND TEST CENTRE

CALIBRATION CERTIFICATE

Certificate No :	CC25016463	Received On	02-09-2025
S.R.F No :	[illegible]	Calibrated Date	03-09-2025
Service Requested By	Nature Science Foundation 9/4 Thadagam Road Edayarpalayam Coimbatore -641025	Cal Due Date Issue Date Calibrated At Procedure No	02-09-2026 04-09-2025 Lab [illegible]

Description of UUC

Instrument Name	Range	Resolution	Make / Model	Sl.No
Digital TDS Meter	0 to 1990 ppm	1 ppm	[illegible]	-

Standards / Calibrators Used

CALIBRATION RESULTS

*** End of Certificate ***

Calibration Certificate of TDS Meter

INSTRUMENTS CALIBRATION AND TEST CENTRE

CALIBRATION CERTIFICATE

Calibration Certificate of Digital Clamp Meter

NATURE SCIENCE FOUNDATION

In-house Calibration – Air Quality Index Meter

Calibration Certificate of AQI Meter

1.10. 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, googles, face shield, hand gloves, shoes, etc.,

1.10.1. 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.

1.10.2. 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.

1.10.3. 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.

1.10.4. 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.

1.10.5. 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.

1.10.6. Ear Plug:

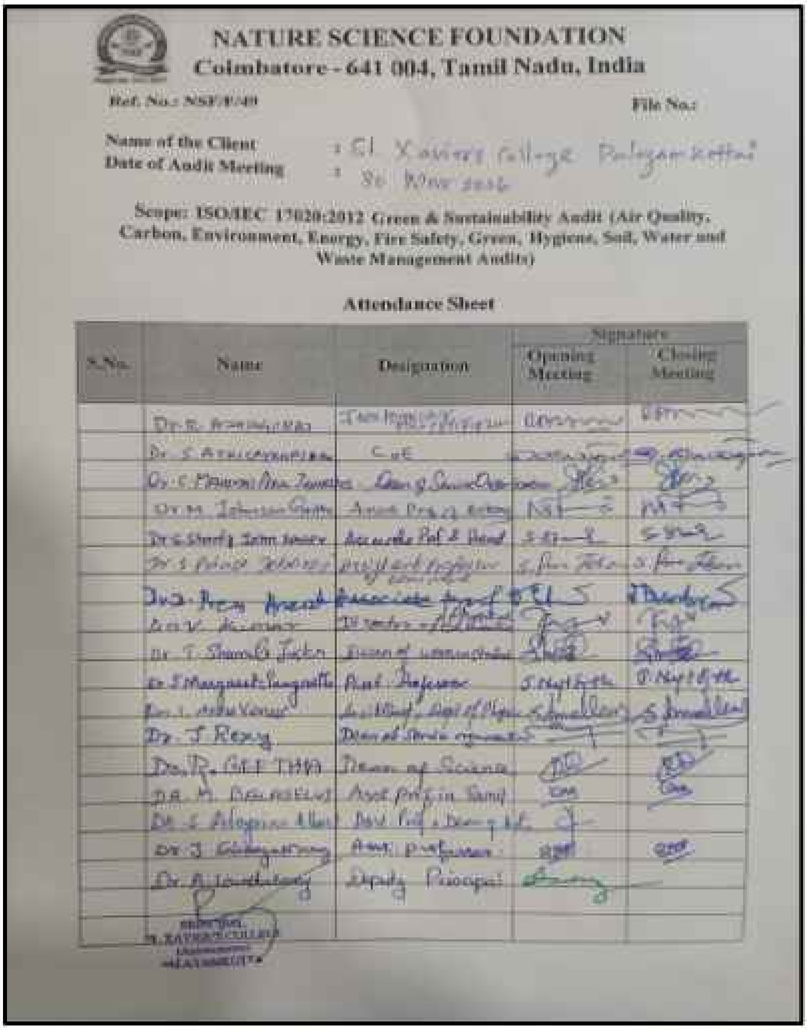
Ear plugs are used for tasks that can cause hearing problems and loss of hearing. Hearing protection devices reduces the noise energy reducing reaching and causing damage to the inner ear. This ear plug is mostly used near sound producing devices like power motors, genets, generators, etc.,

1.11. Opening and closing meetings for Audit Inspections

In order to carry out green and environment sustainability audit inspections, the audit team has visited the organization campus and conducted an 'Opening and Closing Meetings' with all the Top Management people, Head of the Organization, Management Representative, NIRF, IQAC, NAAC Coordinators, Deans, Directors, Heads of various Departments, Green audit Coordinators, ISO Core team members, Quality Manager and staff members. During the opening meeting, the audit processes like campus visit, documents and records verification and discussion with the Top Management people, Head of the Organization, Green audit Coordinators and Quality Manager have been explained by the NSF Inspection Team.

Similarly, closing meeting was conducted at end of the day after the campus visits and documents and records verification with the green and environment sustainability audit core team along with Top Management people, Head of the Organization, Management Representative and Quality Manager. During the closing meeting, suggestions, recommendations and opportunities for improvement have been discussed in brief. Quality Manual, Management Review Meeting records, Internal Audit reports and other Green audit / environment initiatives related documents and records have been checked during the audit process by the NSF Inspection Team. Top management demonstrated a significant commitment to the green and environment sustainability audit activities through academic governance, policy implementation, budget allocation and monitoring of institutional performance.


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



NATURE SCIENCE FOUNDATION
Coimbatore - 641 004, Tamil Nadu, India

Ref. No.: NSF/E/49 File No.:

Name of the Client : St. Xavier's College, Palayamkottai
Date of Audit Meeting : 30 Nov 2016

Scope: ISO/IEC 17020:2012 Green & Sustainability Audit (Air Quality, Carbon, Environment, Energy, Fire Safety, Green, Hygiene, Soil, Water and Waste Management Audits)

Attendance Sheet

S.No.	Name	Designation	Signature: Opening Meeting	Signature: Closing Meeting
	Dr. R. [illegible]	[illegible]	[illegible]	[illegible]
	Dr. S. [illegible]	CoE	[illegible]	[illegible]
	Dr. C. [illegible]	Dean of [illegible]	[illegible]	[illegible]
	Dr. M. Johnson [illegible]	Asst. Prof. [illegible]	[illegible]	[illegible]
	Dr. S. [illegible]	Associate Prof. & Head	[illegible]	[illegible]
	Dr. S. [illegible]	[illegible]	[illegible]	[illegible]
	Dr. S. [illegible]	Associate Prof. [illegible]	[illegible]	[illegible]
	Dr. V. [illegible]	Director [illegible]	[illegible]	[illegible]
	Dr. T. [illegible]	Dean of [illegible]	[illegible]	[illegible]
	Dr. S. Margaret [illegible]	Asst. Professor	[illegible]	[illegible]
	Dr. [illegible]	Asst. Prof., Dept. of [illegible]	[illegible]	[illegible]
	Dr. J. Rexy	Dean of [illegible]	[illegible]	[illegible]
	Dr. R. GEETHA	Dean of Science	[illegible]	[illegible]
	Dr. M. [illegible]	Asst. Prof. in [illegible]	[illegible]	[illegible]
	Dr. S. [illegible]	Asst. Prof. & Dean [illegible]	[illegible]	
	Dr. J. [illegible]	Asst. Professor	[illegible]	[illegible]
	Dr. A. [illegible]	Deputy Principal	[illegible]	

Opening and closing meeting attendance sheet

2. AIR QUALITY AUDIT

2.1. Introduction

When the air is clear and contains only small amounts of solid particles and pollutant then the air quality is determined as good. Air is the mixture of gases, as air is moving its quality can be changed day to day. Temperature, wind movements are also major reason for air quality. Air quality audits play a vital role in assessing the purity of air, ensuring safe respiration for humans and animals, and supporting healthy plant growth. It is being assessed by measuring some parameters such as O_2 and CO_2 along with air quality index in an organization.

2.2. 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_2 Analyzer is used to measure the level of carbon dioxide in the atmosphere at different places across the campus.

2.3. Air quality audit observations (NBC Checkpoint 12.4.3.)

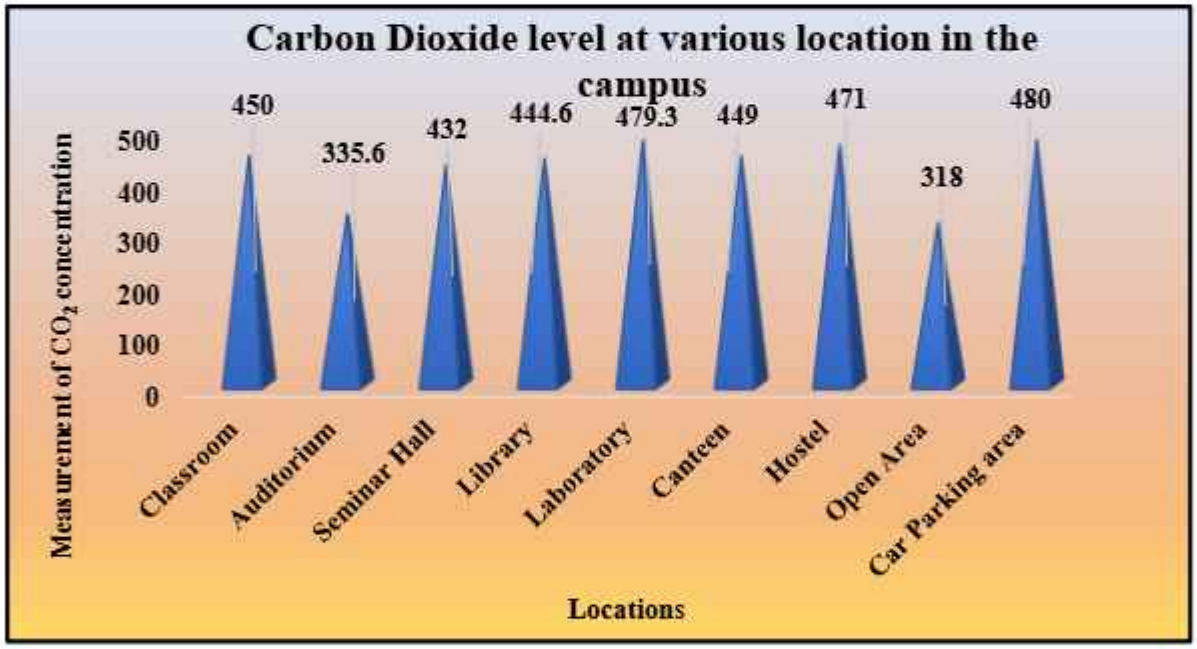
It is observed that carbon dioxide and oxygen values are acceptable range. The air circulation is very good in all the places which in turn useful to give pure air to the stakeholders. The observation showed that the concentration of CO_2 in the atmosphere is found to be optimal which did not exceed the critical limit of CO_2. It is further revealed that all the selected locations are having pure air without any air contaminants with good air exchange/circulation in the campus. Some of the places like canteen, class rooms laboratories, hostels, open places, car parking areas, seminar and auditorium halls are recorded with various level of carbon dioxide level (Table 1 and Figure 1) due to student mobilization and the maximum number of electrical items fixed from which the carbon dioxide emission was observed. The institution promotes green initiatives by developing and enhancing biodiversity spaces, with scope to organize and display various garden types under a unified Biodiversity Garden concept.

Analysis of CO_2 concentration in the Campus by the Lead Auditor

Table 1. Measurement of CO_2 concentration in the Campus

S. No.	Different locations of the Organization's Campus	Carbon dioxide level (ppm)*	Remarks
1.	Classroom	450.0	Within permissible limits
2.	Auditorium	335.6	Within permissible limits
3.	Seminar Hall	432.0	Within permissible limits
4.	Library	444.6	Within permissible limits
5.	Laboratory	479.3	Within permissible limits
6.	Canteen	449.0	Within permissible limits
7.	Hostel	471.0	Within permissible limits
8.	Open Area	318.0	Within permissible limits
9.	Car Parking area	480.0	Within permissible limits
Mean		428.85	
SEC ±		49.26	
CD at P=0.05%		87.79	

Figure 1. Measurement of CO_2 concentrations in the Campus



2.4. Atmospheric oxygen level measurements analysis and interpretation

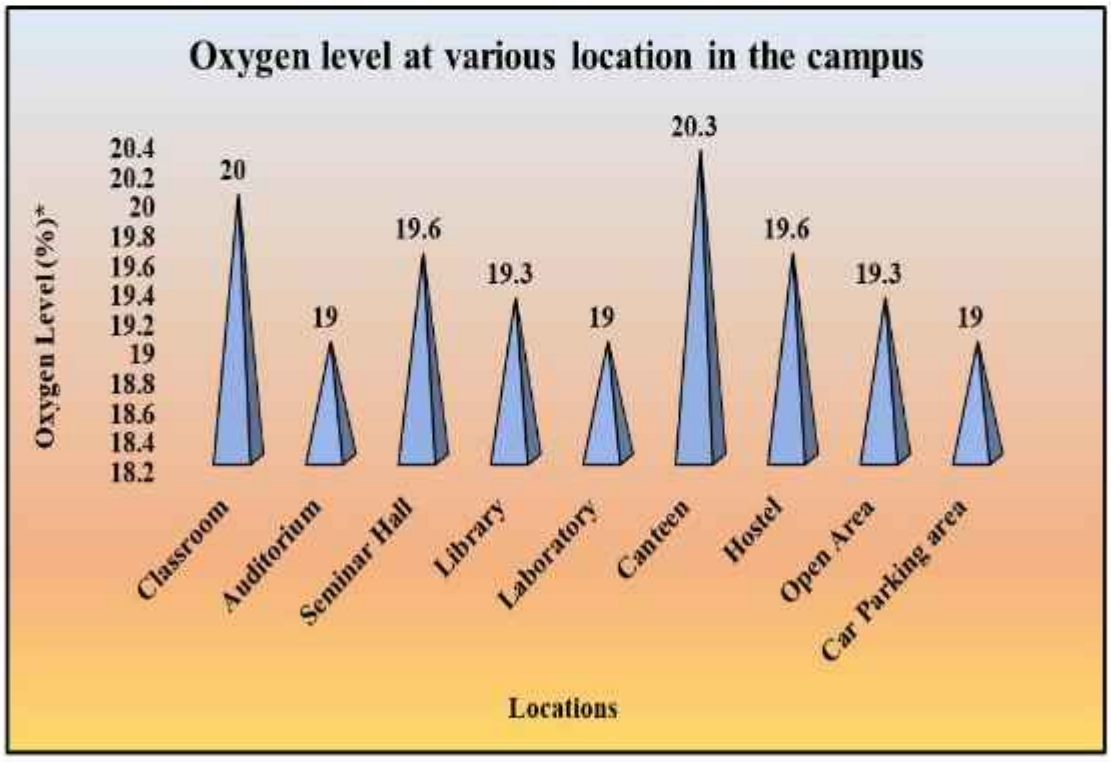
Oxygen level refers to the amount of oxygen available within the atmosphere or water bodies. Oxygen is produced/released as a by-product of photosynthesis, the metabolic activity of all green plants besides certain microbes. Oxygen plays a paramount role in metabolic activities like respiration and the 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 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 2 and Figure 2). To assess the atmospheric oxygen level, tree species are playing important role. Similarly, greenish nature of an Organization campus in terms of trees, herbs, shrubs, climbers, twins, lianas, lawns and reflected in reducing the environmental pollution soil erosion, biodiversity conservation, landscape management, natural topography, green cover area and vegetation.

Table 2. The oxygen concentration at different places of the organization

S. No	Location	Oxygen Level (%)*	Remarks
1.	Classroom	20.0	O_2 level is good
2.	Auditorium	19.0	O_2 level is good
3.	Seminar Hall	19.6	O_2 level is good
4.	Library	19.3	O_2 level is good
5.	Laboratory	19.0	O_2 level is good
6.	Canteen	20.3	O_2 level is good
7.	Hostel	19.6	O_2 level is good
8.	Open Area	19.3	O_2 level is good
9.	Car Parking area	19.0	O_2 level is good
	Mean	19.48	
	SEC ±	0.69	
	CD at P=0.05%	1.23	

Figure 2. Measurement of O_2 concentration in the Campus



Analysis of AQI concentration and O_2 levels in the Campus

2.5. Air Quality Index (AQI) Analysis

AQI has been analyzed using an AQI Meter. It is a kind of measurement tool used to communicate the level of air pollution in a simple and understandable way. In general, it indicated the presence of key pollutants such as PM2.5, PM10, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO) and ozone (O_3). The AQI scale ranges from 0 to 500, where lower numbers signify cleaner air and higher numbers indicate increasing pollution levels. Poor air quality can significantly affect human health, particularly for sensitive groups like children, the elderly and individuals with asthma or respiratory issues. On days when the AQI is high, students are advised to limit outdoor activities, wear N95 masks and stay indoors when possible.

Air Quality Index (AQI) Analysis of different places at the campus are monitored and presented in the Table 3 and Figure 3. AQI scale and PM2.5 / PM10 concentrations according to Central Pollution Control Board of India is given in the Table 4. It is recommended that planting a large number of native trees in the organization using as an air purifiers and reducing vehicle emissions on campus can help to improve air quality in a significant level. Educational institutions should regularly display AQI updates through digital boards or mobile apps to raise awareness among the students.

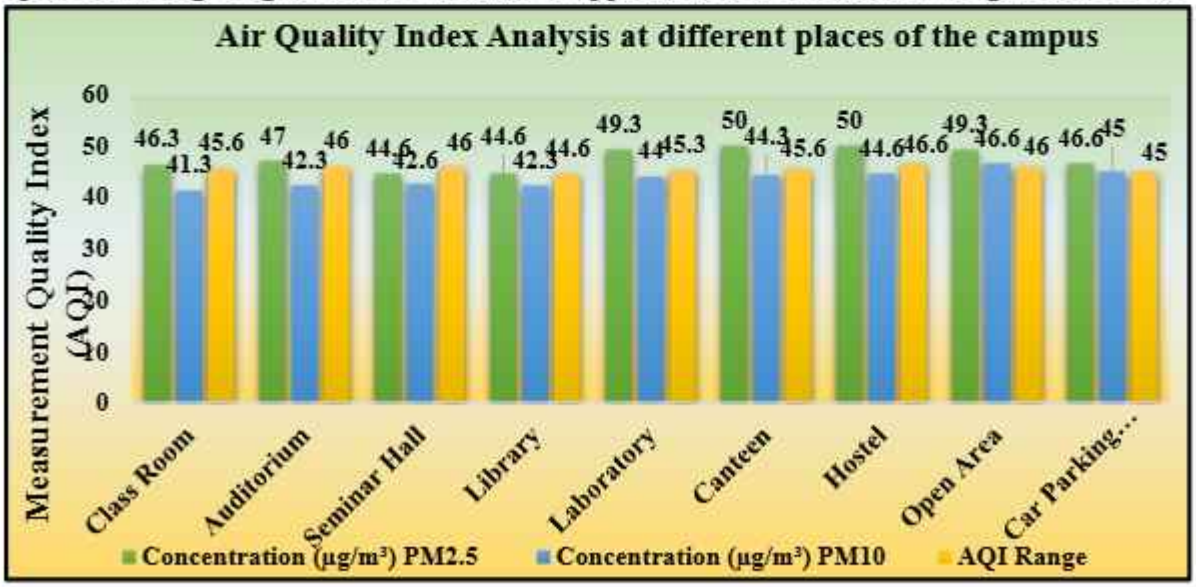


Figure 3. Measurement Quality Index (AQI) in the Campus using a AQI Meter

Table 3. AQI Scale, PM2.5 and PM10 Concentrations according to Central Pollution Control Board of India

S.No.	Places	Concentration (µg/m³)		AQI Range	Remarks
		PM2.5	PM10		
1.	Class Room	46.3	41.3	45.6	Air quality is good with proper air circulation, safe for the stakeholders, well-ventilated learning environment.
2.	Auditorium	47	42.3	46	
3.	Seminar Hall	44.6	42.6	46	
4.	Library	44.6	42.3	44.6	
5.	Laboratory	49.3	44	45.3	
6.	Canteen	50	44.3	45.6	
7.	Hostel	50	44.6	46.6	
8.	Open Area	49.3	46.6	46	
9.	Car Parking Area	46.6	45	45	
	Mean	47.56	43.70	45.67	
	SEC ±	1.53	1.50	0.97	
	CD at P=0.05%	2.73	2.67	1.73	

Table 4. Air Quality Index Analysis at different places of the campus

AQI Scale Range	Concentration (µg/m³)		Category of Breathing Comfort	Health Implications & Possible actions for Indoors and Outdoor Units
	PM 2.5	PM 10		
0–50	0 – 30	0 – 50	Good	Air quality is satisfactory; safe for all for breathing.
51–100	31 – 60	51 – 100	Satisfactory	Minor breathing discomfort for sensitive groups.
101–200	61 – 90	101 – 250	Moderate	Possible respiratory discomfort; limit strenuous outdoor activity.
201–300	91 – 120	251 – 350	Poor	Increased respiratory symptoms likely; reduce outdoor exposure.
301–400	121 – 250	351 – 430	Very Poor	Health effects to avoid the outdoor activity.
401–500	> 250	> 430	Severe	Serious health risks; stay indoors and consider closures.

According to Central Pollution Control Board of India in terms of air quality index (AQI), the category of breathing comfort is good when the AQI scale ranges from 0 to 30 µg/m³ and from 0 to 50 µg/m³ in the case of AQI scale of PM 2.5 and PM 10 µg/m³, respectively. Similarly, the category of breathing comfort is satisfactory when the AQI scale ranges from 31 to 60 µg/m³ and from 51 to 100 µg/m³ in the case of AQI scale of PM 2.5 and PM 10 µg/m³, respectively. If the AQI scale of PM 2.5 and PM 10 µg/m³ exceeds above 250 and 430 µg/m³, it leads to respiratory symptoms followed by serious health risks among the stakeholders.

3. CARBON AUDIT

3.1. Introduction

Carbon audit is a systematic process and data-driven assessment of an organization's greenhouse gas (GHG) emissions to the atmosphere in which GHG takes place by direct (e.g., fuel combustion, company vehicles and etc.), indirect (e.g., purchased electricity, heating/cooling and etc.) and often value chain (e.g., supply chain, business travel, waste and etc.) emissions. It is used to identify the reduction of carbon opportunities, ensure compliance and improve environment sustainability to understand the full environmental impact. In addition, it provides a baseline data for tracking progress, crucial for ESG reporting, risk management and achieving net-zero targets of the organization. Data analysis and key sources revealed for the identification of major emission hotspots within operations. Recommendations and mitigation plan revealed actionable strategies to reduce emissions and improve energy efficiency takes place in the organization.

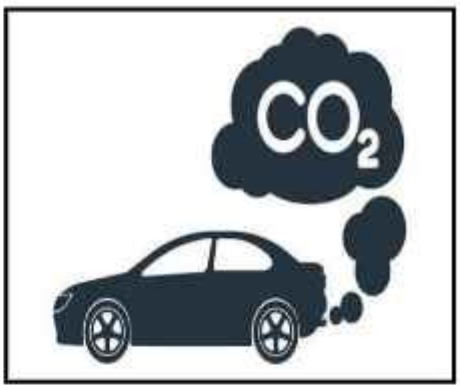
3.2. Carbon audit objectives and methods

Carbon audit is playing an important role in any organizations to identify the major sources of emissions within their operations and supply chain. Once the major sources of emissions are identified within the operations, it is very easy to neutralize the carbon emissions by means of sequestration process by planting a large number of plants in the organization. Carbon audit can guide organizations toward energy efficiency, renewable energy adoption and optimized logistics which in turn is useful to contribute to long-term emissions reductions. As the world increasingly focuses on tackling climate change, conducting carbon audits has become an essential practice for organizations aiming to remain competitive and environmentally responsible. A carbon audit is not only beneficial for environmental impact but also plays a key role in regulatory compliance, meeting sustainability goals and enhancing corporate reputation. By identifying areas for energy savings through carbon audit, the waste reduction and process optimization, organizations can take steps to lower their energy consumption, leading to both financial savings and reduced environmental impact.

3.3. Carbon footprint

Carbon footprint can be calculated in the organization by means of number of vehicles operated, purchase of fossil fuels purchased, electric current used and human population. This information is crucial for creating actionable strategies to reduce their carbon footprint and improve sustainability. Carbon footprint of an organization will be useful to reduce the carbon emission and also helpful the organization to align with climate goals, comply with regulations and contribute to environmental responsibility, fostering long-term operational and reputational benefits. Carbon footprint means measuring/recording thegreenhouse gases (GHG) emissions of an organization within its defined boundary. The air quality audit section covers carbon dioxide and oxygen levels across the campus, while the energy audit section reports the organization's annual carbon footprint from electricity usage per year at the Organization.

3.4. Analysis of Greenhouse gas (GHG) emissions



The carbon footprint per year is calculated (www.carbonfootprint.com) based on electricity usage per year in which CO_2 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_2 in metric tons per year. Humans contribute to a massive increase of carbon dioxide emissions by burning fossil fuels, deforestation, and other industrial activities.

3.5. Organization Details

Table 5. Campus details

S.No.	Details / Descriptions	Quantity
1.	Total strength of Students	4707
2.	Total strength of Employees	344
3.	Total number of Buses in the campus	01
4.	Number of Cars entering in the campus	42
5.	Number of Motorcycles entering in the campus	895
6.	Number of other vehicles (Lorry, Ambulance, Jeep, Trucks, Cranes, Proclaim, and etc. entering in the campus)	Nil
7.	Number of E-Vehicles	Nil
8.	Number of RO Water Plants	04
9.	Number of Bore wells	08
10.	Number of Open wells	04
11.	Number of Water reservoirs	11
12.	Number of Wastewater treatment facility	Nil
13.	Number of Rain water harvesting system	104
14.	Number of Composting pits and Vermicomposting units	02

3.6. Parking facilities to reduce Heat Island Effect (NBC Checkpoint 7.4.1.)

Heat island effect denotes the temperature level. It is observed that the vehicles are parked under the Tree shade 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. Heat island effect protocol defines stationary combustion as the burning of fuels in stationary equipment or devices that do not move. The emissions from stationary combustion are categorized, since they are direct emissions from owned or controlled sources. It recommends using fuel consumption data and applying the appropriate emission factors for each type of fuel consumed.

Vehicles parked under the tree shades to reduce the carbon emission

3.7. Public transport, low emitting vehicles and control of car smokes (NBC Checkpoints 7.4.1. – 7.4.7)

The audited Organization is provided E- Vehicles to maintain eco-friendly environment in the campus and to reduce carbon dioxide emissions. Apart from the e-vehicles, students are encouraged to use bicycles. The tree species are planted abundantly to provide shade to the pedestrian. Greenhouse gas emissions that are not intentionally released through combustion or industrial processes but instead leak or escape from systems due to unintentional releases, such as equipment malfunctions, maintenance activities, or accidental releases. Diesel, Petrol and LPG use witnessed a dramatic increase in emissions from the organization which should be reduced significantly by adopting electric as well as battery operated vehicles.

E-Vehicle Observed in the Campus

3.8. Power consuming equipment and electrical appliances

Other than electrical energy from grid, energy generated using fossil fuels for the year are presented in the Table 6. The sharp rise in electric current consumption petrol / diesel /LPG combustion and other allied emissions are the most significant contributors to the overall increase in emissions.

Table 6. Annual Energy Consumption of Fuels in the Campus

S. No	Month	Diesel consumption (Liters)	Petrol consumption (Liters)	LPG consumption (kg)
1	March 2025	599.35	Nil	18
2	April 2025	299.68	Nil	18
3	May 2025	0	Nil	18
4	June 2025	439.77	Nil	18
5	July 2025	299.68	Nil	19
6	August 2025	899.03	Nil	19
7	September 2025	0	Nil	17
8	October 2025	1498.38	Nil	20
9	November 2025	299.68	Nil	19
10	December 2025	599.35	Nil	20
11	January 2026	599.35	Nil	20
12	February 2026	599.35	Nil	18

3.9. Calculation of carbon footprint

The carbon footprint analysis can be calculated based on the earlier reports as stated in 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_2 emission from electricity

= (electricity usage per year in kWh/1000) x 0.84, where 0.84 is the emission factor in metric tons of CO_2 per MWh

= (412750 kWh/1000) x 0.84

= 346.71 metric tons

According to the above calculations, carbon emission due to electricity usage per year accounts for 346.71 metric tons.

Transportation per year (Shuttle)

= (Number of the shuttle vehicle in the campus x (2) x total trips for shuttle bus service each dayx approximate travel distance of a vehicle each day inside campus only (20 km)x 365/100) x 0.01

= ((1 x 20 x 1 x 365)/100)) x 0.01

= 0.73 metric tons

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)

= (Number of cars entering the campus x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.02

= ((42 x 20 x 1 x 365)/100)) x 0.02

= 30.66 metric tons

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)

= (Number of motorcycles entering the campus x 2 x approximate travel distance of avehicle each day inside campus only (in kilometers) x 365/100) x 0.01

= ((895 x 20 x 1 x 365)/100)) x 0.01

=653.35 metric tons

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

= total emission from electricity usage + transportation (bus, car, motorcycle)

= (346.71+ 0.73 + 30.66 + 653.35)

= 1031.45 metric tons

3.10. Outcome of Carbon audit

The organization should implement the energy efficiency measures for stationary combustion activities, including optimizing fuel mix and exploring cleaner energy alternatives. Further, it is advised to upgrade vehicle fleet to hybrid or electric models and implement telematics to reduce fuel consumption. Regular maintenance and phased replacement of older HVAC/refrigeration systems to minimize refrigerant leakage should be taken into consideration. Monitor and manage emissions trends through improved data tracking and reporting to identify specific sources of inefficiency should also taken into consideration by the Management. The organization's GHG emissions refer to indirect emissions from the consumption of purchased electricity, steam, heating, and cooling. These emissions occur at the power generation source, but the organization is responsible for them due to its demand for the energy. It occurs in the value chain of the organization, both upstream and downstream processes which result from activities such as purchased goods and services, capital goods, business travels, employee commute, waste disposal, etc.

In evaluating the carbon footprint of the organization, it is identified that carbon emission taken place because of fossil fuel-powered transportation and the modes of transportation used by the stakeholders, including the average distance traveled per trip, commuting frequency and the specific emission factors associated with each type of transport. Further it is quantified the overall carbon emissions by multiplying the total kilometers traveled by the relevant emission factors, measured in kilograms of CO_2 per kilometer. The organization must explore more sustainable transportation alternatives to reduce its environmental impact by adopting electric vehicles and bicycles.

4. ENVIRONMENT AUDIT

4.1. 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*., 2021).

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. 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. 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.

4.2. Environmental (Eco) audit objectives

Purpose of the audit is to determine performance of the environmental management systems and equipmentrelated 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. 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.

4.3. Environment audit observations

- The construction is proposed based on the applicable climatic zone and geological conditions.
- Human comforts such as wheelchair access, ramp walks and fire safety measures are thoughtfully incorporated.
- To reduce the demand of water, rain water harvesting system is implemented.
- Training and awareness programmes records are available to maintain sustainability.
- Fire extinguishers are 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.
- Parking is provided under the tree shade to reduce the Heat Island effect (Temperature).
- Use of potable and non-potable waters are identified and differentiated to conserve water.
- Public transport facilities are available in the campus to control air pollution.
- The institution has introduced E-vehicles within the campus and is progressively encouraging greater utilization to enhance sustainable transportation practices.
- Pedestrian pathways are well maintained and enhanced with tree plantations to provide adequate shade.
- No offsite and subsidized parking are encouraged in the campus.
- Biogas plant are available in the campus.
- The institution demonstrates commitment to improving thermal comfort by exploring advanced solutions such as turbo ventilation systems in areas like the canteen.

4.3.1. Integrated Water Management System (NBC Checkpoints 3.7. and 7.2.1.)

Water is one of the major source of living. Per captia water consumption in the building is calculated as per the water management plan (litres / person/ day). To reduce the demand of water consumption rain water harvesting unit is implemented and practiced.

Water Management System observed in the campus

4.3.2. Corporate Governance (NBC Checkpoint 3.10.)

Training and awareness programmes are conducted for stakeholders to promote environmental sustainability. The institution actively organizes activities such as tree plantation drives, campus cleaning initiatives, and community participation programmes. These efforts encourage students and staff to contribute towards green practices and environmental conservation, reflecting the institution's commitment to sustainable development.

Awareness program conducted in the campus

4.3.3. Applicability and Implementation (NBC Checkpoints 4 and 5)

Guidelines of Architect, Designer and Civil contractor for the existing building is under process to be implemented.

4.3.4. Pedestrian path facility at the campus (NBC Checkpoint 7.4.3.)

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.

Pedestrian path and Stone benches available in the campus

4.3.5. Selection of Building Material (NBC Checkpoints 9.1. – 9.3.)

Low carbon emitting cements, bricks, etc., are used for the construction and recycled glass materials are used for windows. Construction material are not stored in the campus. Existing building service life plan is available as per the National Building Code.

4.3.6. Waste and Water management activities (NBC Checkpoint 10.1.)

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. It is observed that colored dustbins are used in the Organization to segregate the waste at the source of generation.

Waste management activities in the Campus

4.3.7. Post Occupancy maintenance

Post-occupancy maintenance activities are being effectively implemented to ensure the facility remains functional and efficient. The facility implements sustainable practices through:

- Regular maintenance of landscaped areas and greenery to sustain a clean and eco-friendly environment.
- Awareness signages such as "Do not waste water" promote responsible water usage among stakeholders.
- Maintenance of a clean and healthy campus environment with initiatives like "Drug-free campus" awareness boards.
- Availability and upkeep of basic healthcare facilities through a dedicated health centre for immediate medical support.
- Continuous monitoring of campus facilities and surroundings to ensure safety, hygiene, and well-being of students and staff.

Post Occupancy maintenances observed in the campus

5. ENERGY AUDIT

5.1. 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 extend. 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). 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.

5.2. Energy audit observations

During onsite audit the 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.
- 'Danger' and 'warning boards' are available near generator and UPS.

- Natural ventilation through windows and shading is available adequately to reduce the energy consumption.
- Low emitting lights are fixed as per the LPD mentioned in National Building Code (NBC), Part -11: Approach to Sustainability ensuring safety and comfort.
- External and internal signage lifts are differentiated to support conserve energy.
- 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.
- Energy-efficiency three star rated appliances (AC, Air cooler, Refrigerator, etc.,) are procured to conserve energy.
- Awareness posters like 'Turn off when not in use', 'Save Energy', etc., placed more to promote awareness for conserving energy in the campus.
- No emissions and leaks are observed.
- Operation and Maintenance manual is followed properly.
- Noise levels observed in the different location resulted in normal range.
- Standard Operating Procedures are available for electrical instruments.
- The campus has initiated renewable energy practices through the installation of solar photovoltaic systems, contributing to clean energy usage.
- The institution is actively moving towards energy efficiency by promoting advanced electrical systems, solar water heating, and sensor-based energy-saving equipment.

5.2.1. Energy Efficient Design and Process (NBC Checkpoints 3.5, 3.6 & 3.8.)

In the campus, it is observed that for lighting, cooling and ventilation renewable sources of energy like solar panel etc., are used. Local resources are made available in post occupant stage as per operation and maintenance plan. Standard Operating Procedures are available for electrical instruments.

Solar panel observed in the campus

5.2.2. Lighting facilities (NBC Checkpoints 6.2.2 – 6.2.10, 7.1.1.2 and 7.5)

External shading facilities are made based on the sun path to reduce the energy consumption. Day light integration is implemented in the building by placing adequate number of windows. 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 lifts are made up of recycled material with maximum light intensity. In the buildings windows head are higher to penetrate day light.

Natural Lighting facilities observed during day time

5.2.3. Building Service Optimization (NBC Checkpoint 11)

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. Energy conservation plays a 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 sub metering facilities, availability of BEE star rated appliances in Air cooler, lift, AC, generator, etc., Solar 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. Emissions and leaks are monitored through operation and maintenance manual.

Energy conservation facilities observed in the Campus

5.2.4. Energy consumption and cost profile (NBC Checkpoint 12.3.4.)

The following chart shows the profile of energy consumed and the cost for one year by the auditee (Figures 4 & 5; Table 7).

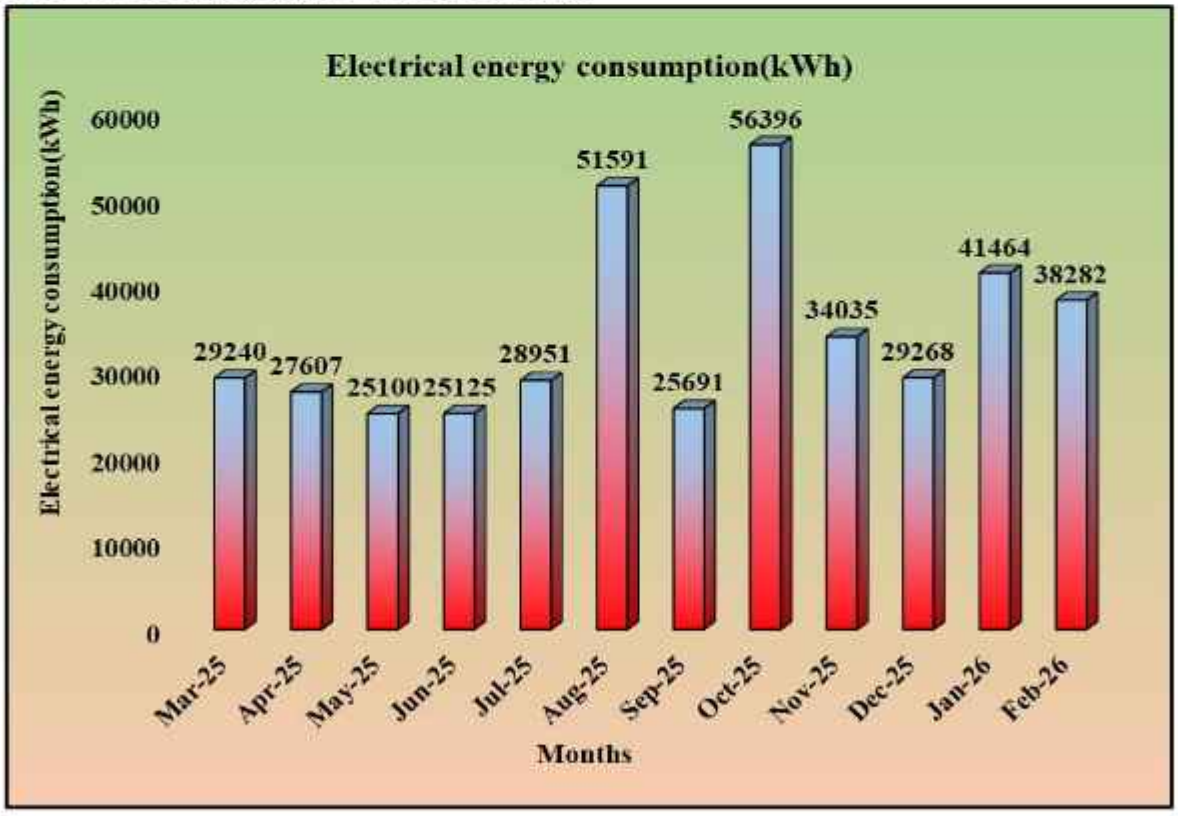


Figure 4. Electrical energy consumption profile

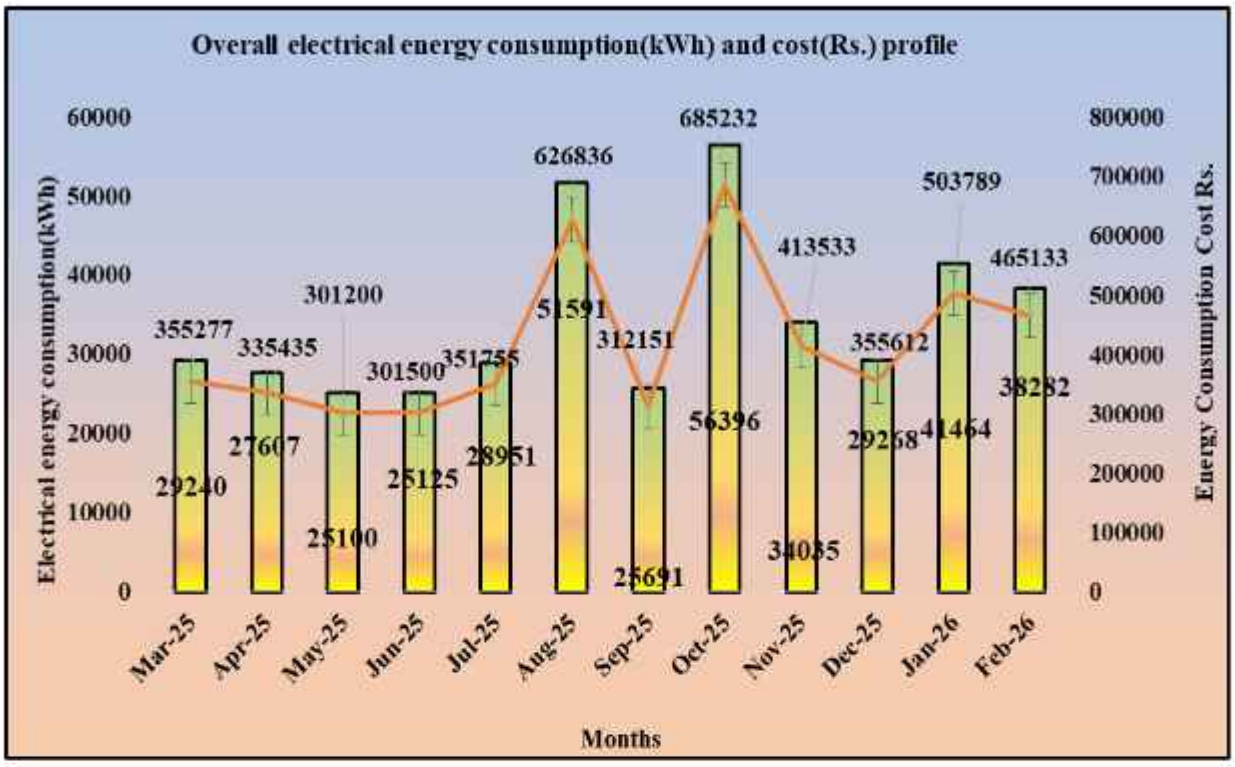


Figure 5. Overall electrical energy consumption and cost profile

Table 7. Electrical energy consumption and cost profile in the Institution

S. No	Months	Rating / Capacity units in kWh	Cost in Rs.
1.	March 2025	29240	355277
2.	April 2025	27607	335435
3.	May 2025	25100	301200
4.	June 2025	25125	301500
5.	July 2025	28951	351755
6.	August 2025	51591	626836
7.	September 2025	25691	312151
8.	October 2025	56396	685232
9.	November 2025	34035	413533
10	December 2025	29268	355612
11.	January 2026	41464	503789
12.	February 2026	38282	465133

5.2.5. Noise level measurements (NBC Checkpoint 12.4.4.)

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). The body can also respond to lower noise levels. Level of noise are expected tobe within 55 dB in residential areas, including institutions. Class room noise levels aresupposed 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 µPa. Noise level prescribed by Central Pollution Control Board was presented in the Table 8. Noise level are measured at various location in the campus are detailed in the Table 9 and Figure 6.

Table 8. Noise level standard prescribed by Central Pollution Control Board, Government of India

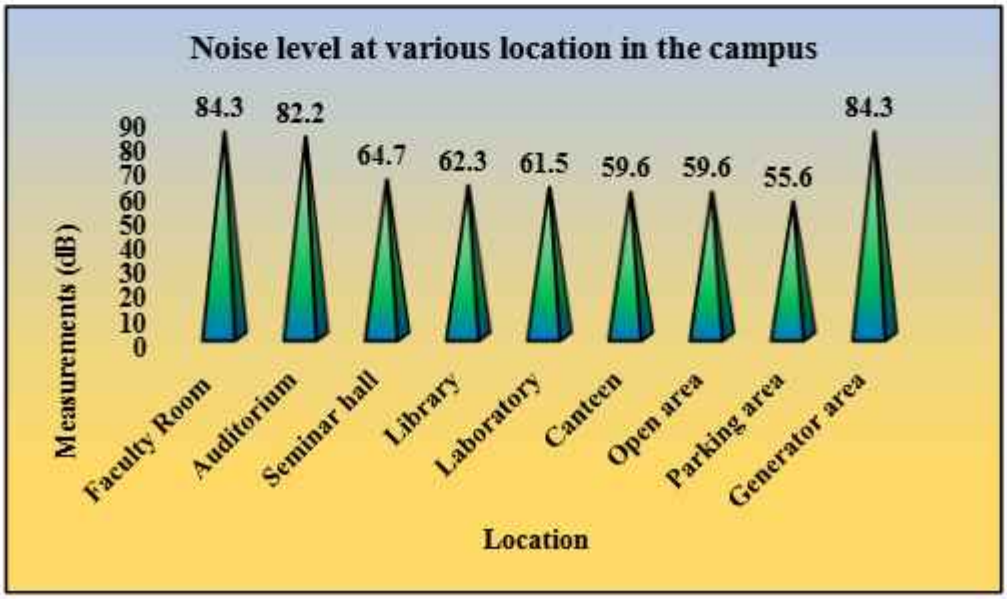
Area Code	Zone	Limits in dB (A) Leq	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence	50	40

Source: IS : 12065 – 1987

Table 9. Noise level at various location in the campus

S. No	Locations	Measurements (dB)	Major noise sources	Remarks
1.	Class room	84.3	Students and Staff	No Noise Pollution
2.	Auditorium	82.2	Students	No Noise Pollution
3.	Seminar hall	64.7	Students	No Noise Pollution
4.	Library	62.3	Staff members	No Noise Pollution
5.	Laboratory	61.5	Students	No Noise Pollution
6.	Canteen	59.6	Students and Staff	No Noise Pollution
7.	Hostel	59.6	Students	No Noise Pollution
8.	Open area	55.6	Students and staff	No Noise Pollution
9.	Car Parking area	84.3	Vehicles	No Noise Pollution
	Mean	68.27		
	SE	6.72		
	CD	11.98		

Figure 6. Noise level at various location in the campus



Noise level measured in various locations at the Campus

5.2.5.1. 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. Light intensity measured at various locations in the Campus are detailed in the Table 10 and Figure 7. The observation revealed that the illuminances are varied from varying levels in the campus which are recorded within the range. If illuminances are exceeding the limit, light pollution takes place which affect the human health, wildlife and environment significantly. It disrupts ecosystems by altering natural light cycles, causes fatal migratory confusion in birds and sea turtles, triggers health issues like sleep disorders in humans, and wastes energy.

Table 10. Light intensity measured at various locations in the Campus

S.No	Type of Spaces	Illuminances (LUX)
1.	Class room	156.8
2.	Auditorium	67.6
3.	Seminar hall	68.53
4.	Library	128.9
5.	Laboratory	68.9
6.	Canteen	111.5
7.	Hostel	186
8.	Open area	367.6
9.	Car Parking area	235.6
	Mean	154.64
	SE	33.65
	CD	59.96

Source: IS: 6665-1972

Light intensity analysis in the Campus

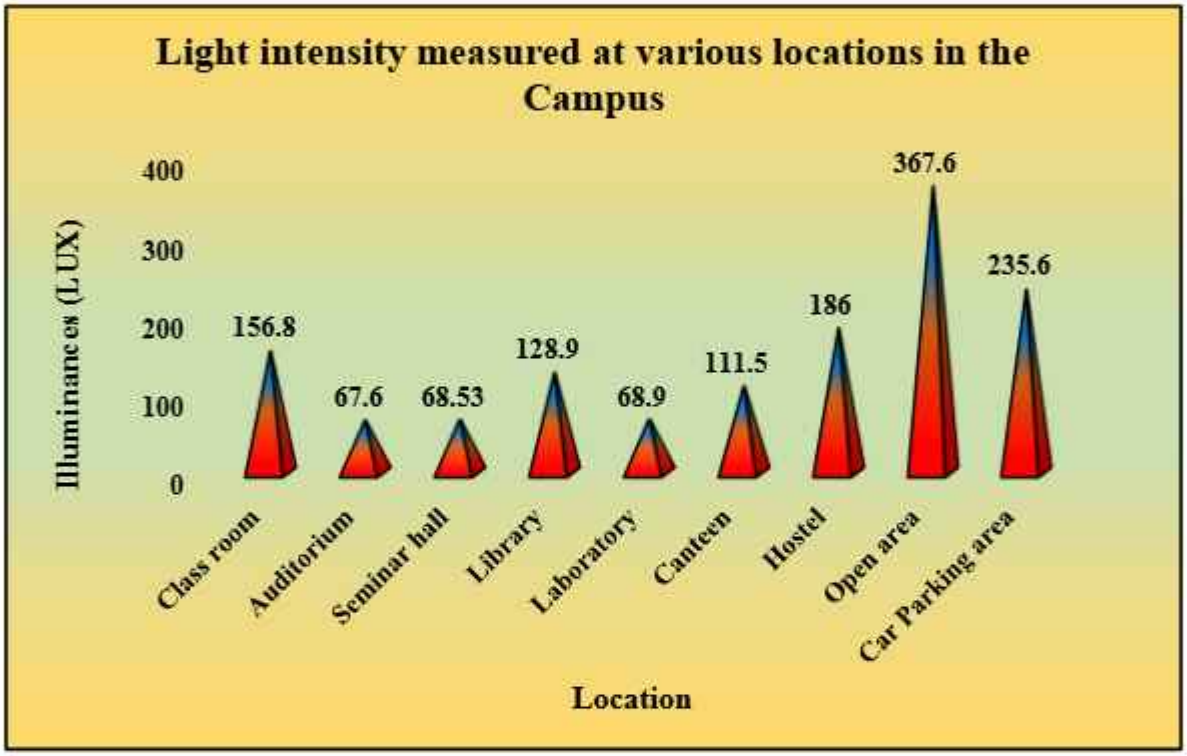


Figure 7. Light intensity Measured at the campus

5.2.5.2. Voltage Measurement at the Campus

Voltage measurement in alternate current (AC) and direct current (DC) supply at different places in the campus is measured using the clamp (voltage) meter which in turn useful to assess the energy (current) consumption of the organization. The results are shown in the Table 11. The observation revealed that the energy (current) consumptions are varied from varying levels in the campus which are recorded within the range. If energy (current) consumptions are exceeding the limit, the organization should spend more amount of money towards the electric bills and also affect the environment. In order to reduce the electric bills, solar panel, solar street light and automatic sensor based lighting are being recommended. In addition, AC and DC are fluctuating, both electrical and electronic appliances will be damaged for which the Organization should take sufficient efforts including energy conservation opportunities.

Table 11. Voltage measured at various locations in the Campus

S.No	Name of the Place	AC & DC Voltage Measurement [Volt (v)]
1.	Class Room (AC)	209.6
2.	Auditorium (AC)	220.3
3.	Seminar Hall (AC)	219.3
4.	Library (AC)	219.6
5.	Laboratory (AC)	219
6.	Canteen (AC)	225
7.	Power Room (AC)	220
8.	Generator Area (AC)	219
9.	Battery (DC)	200
10.	Solar Panel (DC)	48
SD±		51.02

Source: BEE, 2015, Bureau of Energy Efficiency

Voltage intensity measured at the Campus

5.2.6. Operation and Maintenance (NBC Checkpoint 13)

During commissioning and handover, operation and maintenance plan for buildings was made and proper training was given to the correspondence staffs, which is evident through Operation and Maintenance (O&M) plan. An effective O&M Plan is a structured document that ensures systems operate efficiently, extends equipment life, and reduces repair costs, typically covering preventive, predictive and corrective actions. The primary objective of this O&M Plan is to define the scope of monitoring programmes to be conducted to (1) evaluate changes in conditions in ground water on-site and (2) evaluate the effectiveness of the existing building at the site which serves as a mitigation measure to address the vapour intrusion exposure pathway. Although prior work plans prepared for the site summarize certain monitoring requirements for the site, this document is intended to provide the comprehensive scope for current and future monitoring programs. It includes asset inventory, maintenance schedules, safety procedures and contractor management to ensure occupant comfort. The organization has well-structured O&M Plan for all the buildings with proper safety measures.

6. FIRE SAFETY AUDIT

6.1. Introduction

Fire safety audits for all types of buildings and industries, including hotels, hospitals, homes, schools, manufacturing plants, chemical plants, power plants, FMCG companies, foundries, mines, etc. are conducted to check the fire hazardous materials and ensure the place which is free from fire incidents. The occurrence of fire has the potential to cause serious damage to life and property. A fire safety audit is the most effective tool to assess the fire safety standards of your facility. It helps owners identify areas for improvement and develop action plans, in addition to preparing for emergencies and conducting test drills. There are some fire safety audits checklists to conduct fire safety audits based on various IS standards such as Standard for Automatic Fire Detection and Alarm System, Installation and Maintenance of Emergency and Fire Extinguishers for fire safety of buildings and all other relevant safety standards to identify all the hazards that need to be corrected and prevented.

Prior to the fire safety audit, it has been collaborated with auditing team to gather essential documentations and records including building plans, fire safety equipment details and evacuation procedures. The expert audit team comprising professionals from diverse departments is formed to ensure a thorough assessment. Clear objectives has been set and timelines are established to streamline the audit process. Fire safety audit defines the areas, departments and processes within the facilities of the organization that will be evaluated. The objectives are tailored to the fire safety standards and regulations of both Central and State Governments, which include identifying potential fire hazards, evaluating preventive measures and verifying staff training. This focused approach ensures a systematic and efficient fire safety audit process.

6.2. Safety measures and green building conservation code (NBC Checkpoint 3.11.)

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. Management should extend by issuing guidance and the best safety tools. The organization has 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. Disaster management plan and emergency preparedness are available as the safety of the stakeholders.

The audit team reviewed the organization's fire safety policies and procedures, conducted interviews with key personnel responsible for fire safety and performed on-site inspections to identify potential fire hazards. In addition to evaluating the organization's compliance with both Central and State Governments fire safety regulations and building codes, the audit team also assessed the effectiveness of fire

detection and alarm systems, emergency evacuation plans, fire suppression equipment and staff training programmes. In the fire safety audit process, the organization undertook a comprehensive fire safety audit aiming to enhance safety protocols and life safety risk. This impact story delves into the challenges faced, innovative solutions deployed, adherence to international standards of fire and safety in organization and the significant value created for the clients as well as their stakeholders.

Fire safety measures and first aid kit were observed inside the campus

6.3 Fire Safety Observations

The fire safety audit checklist, in line with the National Building Code, Part II: Approach to Sustainability, covered 11 checkpoints. During the onsite visit, auditors assessed each checkpoint for applicability and verified compliance through records, documentation, and physical observation. The evaluation was based on two parameters: meeting the requirements and scope for further improvement. Compliance indicates that the existing practices, documentation, and safety measures are in accordance with the prescribed standards. The institution has established fire safety systems, including the provision of fire extinguishers and basic safety infrastructure. Further strengthening can be achieved through periodic refilling, systematic identification numbering, and maintenance of detailed service records to ensure effective traceability and readiness of fire safety equipment. Periodic review and timely replacement of medicines and surgical items in the first aid box may be ensured to maintain readiness for emergency medical support. Additionally, fire extinguishers installed in laboratory areas may be inspected and replaced/refilled periodically to ensure operational effectiveness and safety compliance.

7. GREEN AUDIT

7.1. 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. 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, Part - 11: Approach to Sustainability parameters and assessment of risk at 360° view.

7.2. 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. A clean and healthy environment will enhance an effective teaching/learning process. They shouldcreate 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*., 2023). 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.

7.3. Green audit observations

- It is observed that the Organization has ramp walk, wheel chair and lift facilities for disabled and different age group people.
- Monitoring plan is available for the periodic checking at regular interval to maintain sustainability.
- Adequate training and awareness programmes are conducted to the Stakeholders to promote 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.
- Vegetation is maintained around the building to reduce energy consumption and maintain indoor climates.

- Landscape designs are planned to maintain the natural capacity of the site.
- Soil health is maintained well without using any chemical fertilizers.
- The campus may be added innovative approaches such as integrating digital tools (e.g., QR codes) to enhance awareness and accessibility of plant information.
- The institution has developed ornamental gardens, herbal gardens, and green roof/greenhouse facilities within the campus, reflecting its commitment toward biodiversity conservation and enhancement of green infrastructure.

7.3.1. Facilities for Human Comforts (NBC Checkpoints 3.2. and 3.9.)

As per the National Building Code, Part - 11: Approach to Sustainability parameters under elements of sustainability quality of plumbing services and buildings are maintained in line with the standard. Ramp walk facility are implemented for the benefit of disabled and different age group people. As no blind persons are observed in the campus divvying (blind) reading software, signages are not available. Water management, waste management, operation and maintenance plan are followed to maintain sustainability as per the standard.

Wheel chair, Ramp Walk and lift facilities were observed for the comfort of person with disability.

7.3.2. Natural topography, vegetation and monitoring (NBC Checkpoint 6.2.4.)

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

7.3.3. Landscape design and soil erosion control (NBC Checkpoints 7.1.1. – 7.1.3.)

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. Microclimatic conditions are considered, during winter season watering to plants are controlled as per the water management plan. External landscapes are designed based on the shading pattern of the building. Green vegetation are available around the building to reduce the energy consumption.

Landscape design of the Organization building

7.3.4. Establishment of different gardens, vertical landscaping and roof gardens (NBC Checkpoints 7.1.1. – 7.1.3.)

It is observed that Organization has implemented and maintaining gardens to lower the energy consumption. To maintain certain biomass critical for human health and also to reduce the bio-retention through water flow rates different types of gardens like ornamental garden, herbal gardens and green roof/greenhouse facilities are implemented in the campus.

Ornamental, herbal, and green roof gardens are observed in the Campus

7.3.5. Survey of Flora and Fauna (NBC Checkpoints 12.4.5. and 12.4.6.)

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 in the green campus are recorded for the rich flora which are being considered as a value addition to the campus. The campus has a large number of trees, herbal plants, shrubs, climbers, lianas, twiners and lawns. It is further observed that all the plants are growing profusely and showing healthier free from pests and diseases attack. The campus has a large number of oxygen producing and carbon dioxide assimilating plants which are giving pure air to the stakeholders. There are some plants which are being considered highly efficient in oxygen production and carbon dioxide absorption which in turn reflected the quality of the green campus. Maintaining the green campus and water conservation mechanisms is applied efficiently in the campus. The entire green cover area of the campus is highly appreciated.

8. HYGIENE AUDIT

8.1. Introduction

A hygiene audit will provide an insight into how an organization operates in a sustainable manner in terms of hygiene environment to the stakeholders as per the International Standard for Occupational Health and Safety Management Systems (ISO HSMS). If an organization has a hygiene auditing process implemented already, then it should apply environmental context into a clean environment. Environmental audit is a natural management tool and it will become more effective when hygiene audit is added to it. It is an essential requirement to adopt an audit process for a sustained utilization of resources in a hygienic way in both developed and developing countries like India. Hygiene will be of different types such as personal hygiene, environmental hygiene, medical hygiene and public hygiene which are all interrelated between each other in terms of maintaining a hygienic atmosphere to the stakeholders.

To ensure that the hygienic environmental management system, maintenance of environmental and personal hygiene, availability of clean resources, maintenance of water supply and hygiene, cleanliness ensured at the site of disposal of human waste materials and personal safety in the campus should be implemented effectively. Each year a plan for the hygiene audit should be prepared by the management of an organization. A committee of faculties and student representatives and social aware members appointed to take this plan forward in the beginning of every year will ensure that the entire hygienic environmental management system is implemented in the organization without any hindrance. An effective hygiene practice should be followed among the stakeholders which in turn useful to control a wide variety of disease outbreaks. Every organization should have applicable regulations, policies and standards with respect to hygienic environment.

8.2. Hygiene audit observations

- No person is suffering from a disease or illness or with open wounds or burns among the students, teaching and non-teaching staff members including supportive staff and management people across the campuses observed during the hygiene audit which indicated the campus is very keen interest in providing good hygiene atmosphere to the stakeholders.
- The sanitizing materials such as soap, liquid detergent, tissue paper role, hand gloves, hand towels, etc. are made available nearby the washbasins and restrooms focusing towards the personal hygiene and sanitation related concerns to the stakeholders.
- Appropriate dustbins and eco-friendly covers are made available at laboratories, canteens, food courts, cafeteria and hostels across the campuses to control the spread of wastes and contaminants from one place to another place and without harming the environmental health.

- The pest management strategies adopted (cockroach traps, rodents control measures, insect repellents and other control facilities) at the campus is very good.
- The laboratories, classrooms, hostels, canteens, food courts and toilets / restrooms are very neat and clean with proper ventilation and exhaust system.
- Food and Waste handlers are equipped with suitable personal safety materials like disposable hand gloves, full cover aprons and caps to be used frequently to minimize contamination and fire hazards at hostel dining halls and canteens to minimize contamination and fire hazards.
- Pest control programmes for cockroach, house flies, mosquitos, rodents etc. are effectively implemented and pest control activities (eggs, larvae, pupa, faeces, etc.) are carried out by trained and experienced personnel and no signs of pest activity or infestation in the Organization premises is noticed.

8.2.1. Observation on Personal and environmental hygiene and Safety measures (NBC Checkpoints 12.3.6 and 12.3.7.)

As far as the stakeholders and employees are concerned, the safety and convenience of everyone working/access to the organization, the following safety rules should be observed at all times. Wearing a laboratory coat or apron along with hand gloves and caps before entering a working environment for protecting clothes from contamination or accidental discoloration by staining solutions are always mandatory in Organization's hygiene. The observation on providing hygiene environment to the stakeholders at campus revealed that sanitizing materials such as soap, liquid detergent, tissue paper role, hand gloves, hand towels are made available nearby washbasins and restrooms focusing towards personal hygiene and sanitation related concerns. It is observed that working tables and benches are kept clean at laboratories across the Departments. Appropriate dustbins and eco-friendly covers are made available at laboratories, canteens, food courts, cafeteria and hostels across the campuses. At hostel dining halls and canteens, food suppliers are tied their long hairs properly and wear disposable hand gloves, full cover aprons and caps to be used frequently to minimize contamination and fire hazards. Canteen is functioning hygienically and authorized by the management.

Details of pest management strategies adopted (cockroach traps, rodents control measures, insect repellents and other control facilities) at the campus is very less available. Food preparation (kitchen) area at hostels and canteen is very clean, free of insect pests and in good state of ventilation and exhaust system along with proper water supply and drainage. It is observed that waste disposal area and waste disposal collection center are neat and regularly cleaned, free of insect pests and free of spillage with no stagnation of water in food zones. The hygiene audit is playing an important role for both people and the environment of any organization in terms of safety by promoting the hygiene management practices and sanitization standards in the enterprise.

Insect trap and kitchen workers in the kitchen wore caps were observed in the campus

8.2.2. Napkin disposal facility

The campus is taking proactive steps to promote safe and hygienic disposal of sanitary napkins through small-scale incinerators, although there's room for improvement in their maintenance. Incinerators facility and disposal structures in the proper directions and other social stigmas connected to menstruation influences the sanitary waste disposal conduct of women within the campus is very much appreciated. The Management is taking care of adolescent girls and ladies significantly in terms of their personal hygiene and safety. Sanitary napkin disposal facilities such as electrical incinerators and specialized bins, provide hygienic, eco-friendly and instant disposal of waste, reducing drain blockages and odor in washrooms. Environmentally responsible sanitary napkin disposal focuses on reducing landfill waste and preventing air, soil and water pollution which lead to the adverse effect of environment.

Napkin vending machine and incinerator observed in the campus

8.3. Legal compliances

In this campus, they following legal appliances have been verified as per the National Building Code (NBC), Part - 11: Approach to Sustainability parameters. Some of the documents are verified in onsite inspection are Building approval plan, canteen approval license to procure FSSAI certified food products and personal hygiene is evident from the management maintenance record.

FSSAI Certificate observed in the campus

9. SOIL AUDIT

9.1. Introduction

Soil is the inequitable natural resources and naturally occurring loose covering on the earth's surface. Weathering altered the rock particles of soil into mixtures of mineral and organic constituents. Soil is rich in microorganisms such as bacteria, fungi, actinomycetes, algae, protozoa and nematodes. The microorganism of the soil helps in enzymatic degradation of organic matter, energy storage and conversion of nutrients in available form in their biomass. In general, soil is the natural ecosystem of the organization that has to be structured, planned and developed from the point of entry to end users the stakeholders in such a way with contamination free soil without any chemical residues, sustainable use of land and suitable measures for their conservation.

Soil audit plays an important role to provide crucial data for sustainable agriculture, environmental management, and other fields by assessing soil health, nutrient levels, and contaminants. Environmentally, audits can identify contamination risks, track long-term soil health, and inform waste disposal practices. For construction and engineering, soil audits assess compaction and stability. Soil audit helps the educational institutions and industries to maintain eco-friendly environment, assures personal hygiene to various stakeholders and supports the nation; on the whole for the noble cause of environmental protection and nature conservation which in turn enhances the quality of life of all living beings. Most of the soil in India are well drained, deep, fairly loamy, slightly acidic to alkaline and lime-free soils and they are ideal for variety of plant cultivation. The Indian soils are mainly containing large amount of mica with good behaviour of water holding capacity with abundance of micro and macro elements. Some of the soils are characterized by clay loam type, classified as latosols with good organic matter contents along with sufficient amount of nitrogen, potassium and phosphorous contents all tea soils are distinctly acidic, rich in nitrogen content.

9.2. Soil audit observations

1. The physic-chemical properties of soils revealed that the soil health is good towards the construction of building and the cultivation of various native and wild type plant species in large scale level.
2. By analyzing various nutrient levels, pH, texture and water holding capacity, it is suggested to select the right native plants species for cultivation in the organization with appropriate fertilizer applications in soil ecosystem.
3. Regular audits help monitor soil health over time, allowing for long-term management strategies that maintain productivity and prevent degradation.
4. It identifies issues like nutrient deficiencies, toxicities, or pH imbalances, enabling corrective actions before they impact plant species health.
5. By avoiding over-fertilization, soil audits reduce nutrient runoff into water bodies, which can cause eutrophication and other pollution.
6. Audits are used to detect contaminants such as heavy metals or organic pollutants, which is essential for environmental clean-up and risk assessment.

9.3. Geology, topography and soil condition (NBC Checkpoint 12.4.1)

St. Xavier's College (Autonomous), Palayamkottai, Tirunelveli – 627 002, is situated in a region characterized by predominantly flat terrain with slight undulations and an elevation above mean sea level. The area falls under a semi-arid climatic zone and is influenced by the nearby Tamirabarani River, which supports groundwater recharge and vegetation in and around the campus. The geology of the region mainly comprises hard rock formations such as granites and gneiss, which are typical of the southern peninsular region and provide a stable foundation for construction. The soil profile is largely composed of red loamy and sandy loam soils with moderate fertility and good drainage characteristics. In some areas, the soil may be slightly alkaline in nature. These geological and soil conditions are suitable for infrastructure development and landscaping, contributing to the stability, sustainability, and effective maintenance of the campus environment.

9.4. Assessment of Physico-chemical property of soil samples

Soil physic-chemical properties influence the behaviour of soil and hence, knowledge of soil property is important. Soil testing is the only way to understand the soil health and to determine the available nutrient status in soil. The fertility of the soil depends on the concentration of N, P, K, organic and inorganic materials, conductivity. The results on soil samples analysis revealed that the pH, Electrical conductivity, total organic carbon, total nitrogen, available phosphorous and exchangeable potassium were found to be within the range and suitable for building constructions and cultivating the plants corresponding to the soil health (Table 12). The soil samples were analysed with the help of ISO 17020 accredited lab and correlated with the standard values referred from 'Soil Testing Methods in India' published by the Ministry of Agriculture, January 2011 Edition, Government of India for reference (Table 13).

Table 12. Soil sample test result of the Organization

S.No	Test Parameters	Value	Unit	Test Protocols	Comments
1.	pH @ 25°C	7.57	-	IS 2720: (Part 26)	Sufficient
2.	Electrical Conductivity	0.58	ms / cm	IS 14767	Sufficient
3.	Total Organic Carbon	1.02	%	IS 2720: (PART 22)	Sufficient
4.	Total Nitrogen as N	0.82	%	IS 14684 (Estimated as N content)	Sufficient
5.	Available Phosphorus as P	BDL (DL: 18)	mg / kg	ATL/SOIL/SOP – 03 Issue No / Date: 01/ 02.02.2018	Sufficient
6.	Soluble Potassium as K	27.2	mg / kg	ATL/SOIL/SOP – 05 Issue No / Date: 01/ 02.02.2018 (Based on FAO Manual)	Sufficient
7.	Total Moisture content	18	%	IS 15106	Sufficient

Table 13. Range of soil nutrients status:

S.No.	Soil Nutrients	Soil Fertility Ratings (%) *		
		Low	Medium	High
1.	Organic carbon as a measure of available Nitrogen (%)	< 0.5	0.5-0.75	>0.75
2.	Available N as per alkaline permanganate method (kg/ha)	<0.2	2.0 – 5.0	>5.0
3.	Available P by Olsen's method (kg/ha) in Alkaline soil	<5	5-10	>10
4.	Available K by Neutral N, ammonia acetate method (kg/ha)	<25	25-35	>35

Standards referred from 'Soil Testing Methods in India' published by the Ministry of Agriculture, Government of India and Methods of Analysis of Soils, Plants, Waters and Fertilizers by Fertilizer Development and Consultation Organization.

Soil Sample Collection in the Campus

9.5. Physico-chemical properties soil collected from of the Organization Campus

The physico-chemical properties of soil influence the behaviour of soil and hence, knowledge of soil property is important. Soil testing is the only way to determine the available nutrient status in soil and the only way we can develop specific fertilizer recommendations. Soil samples were collected from different places of the organization campus and then subjected to analyse for their fundamental soil edaphic parameters such as pH, electrical conductivity (Ec), total organic carbon, total nitrogen, available phosphorous, exchangeable potassium, total ferric and ferrous ion concentration, manganese, magnesium, zinc, copper. The soil profile and soil edaphic parameters of the campus observed is optimal in terms of essential nutrient analysis and soil fertility. The results indicated that pH and Ec recorded values were found to be within the prescribed ranges. The results indicated that the soil both micro and macro-elements were found to be optimal.

10. WATER AUDIT

10.1. Introduction

Water is one of the most essential natural resources, with around 97% existing as salt water and only 3% as fresh water accessible on land. The use of water is inevitable in our daily needs. Water is used in agriculture, industries, household, recreational and environmental activities every day. In general, the natural sources of fresh water are surface water and ground water. A water audit is a tool used to assess and improve the management of water resources, ensuring better quality for human and animal consumption, as well as efficient use in agriculture through irrigation. It creates awareness on environmental ethics, resolves environmental issues and offers solutions to various social and economic needs. It strengthens the concept of 'Jal Jeevan Mission' and 'Sustainable Land Management' among stakeholders of India for the protection of natural ecosystems for future prospects.

Water audit helps the educational institutions and industries to maintain eco-friendly environment, assures personal hygiene to various stakeholders and supports the nation; on the whole for the noble cause of environmental protection and nature conservation which in turn enhances the quality of life of all living beings. A water audit is a systematic process of analyzing water use to identify where water is consumed, lost, or wasted, with the goal of reducing consumption and improving efficiency. It involves measuring and tracking water from its entry point, through its use and potential leaks, to its discharge point. The process helps to pinpoint inefficiencies, suggest conservation measures, and can be applied to various scales, from a single building to an entire organization.

10.2. Key components and steps involved in the water audit

10.2.1. Water balance calculation: Determine the total amount of water entering the system and account for all uses and losses.

10.2.2. System mapping: Create a layout of the water supply system, including sources, the distribution network, and where water is used or discharged.

10.2.3. Flow measurement: Install meters at strategic points to measure water flow, such as at the source, treatment plant, and distribution networks.

10.2.4. Leakage and waste identification: Systematically check for leaks, inefficient fixtures, and other forms of waste.

10.2.5. Consumption pattern analysis: Study how water is used and identify areas for improvement.

10.2.6. Recommendation development: Based on the findings, the audit report provides recommendations for water conservation, improved treatment, and waste reduction, often with cost-benefit analyses.

10.2.7. Record keeping: Establish a system for ongoing monitoring and record-keeping to maintain a history of water use and manage it effectively.

10.2.8. Physico-chemical property of Water: Colour, taste, odour, viscosity, pH, TDS, dissolved oxygen, micro and macro elements and etc. will be tested in water samples.

10.3. Water audit observations

1. The campus has well established rainwater harvesting models to recharge the bore wells by collecting rainwaters from the building roofs, open areas and playgrounds including unexplored areas which are maintained properly.
2. The physic-chemical properties of water revealed that water is good for human consumption and also useful for plant watering purpose.
3. The water quality parameters revealed that the quality of water is good in terms of domestic purposes.
4. A rainwater harvesting system is available in the campus for groundwater recharge, and proper display with traceability of the system may be enhanced for better monitoring.
5. Low flow fittings, low cisterns and bath faucet are available to conserve water.

10.4. Water management activities (NBC Checkpoints 7.3, 10.2 – 10.5 and 12.4.2.)

In order to conserve water resources, it is essential that any environmentally responsible institution should examine its water use practices. Water auditing is conducted for the appraisal of facilities of raw water intake and determining the facilities for water treatment and reuse. Auditor concerned investigates the relevant method that can be adopted and implemented to balance the demand and supply of water. The Organization is taking enough attempt to manage wastewater that are coming out from various Department laboratories, hostels and canteens as per the water management plan. Chemicals like bromine and chlorine are avoided to maintain the water quality and to maintain hygienic environment to the stakeholders. Low flow fitting are implemented in the recently constructed building to conserve water.

Bore well observed in the campus

10.5. Operational water supply systems

Maintaining the green campus, water conservation mechanisms should be applied efficiently in the campus. Well planned water irrigation systems like sprinkler and drip should be implemented in the entire green area of the campus for an effective water management system. This can be implemented only when the plantations are well planned. Vegetative area of the audited organization has taken sufficient efforts to maintain the plants greenish and frequency of watering to the plants.

Irrigation and drinking water supply systems observed in the Campus

10.6. Rainwater harvesting system and percolation pond

Rainwater harvesting system is a traditional old practice not only in drought prone areas and also in areas having seasonal rainfall. Indian traditional rainwater harvesting systems are constructed based on three modes either direct pumped, indirect pumped or by both modes. In addition, lakes, ponds, water channels and any other water reservoir methods are considered as the rainwater harvesting system. During the audit it has been observed that the organization has developed rain water harvesting system and properly maintained.

Rainwater harvesting system observed in the campus

10.7. Water quality

After air, water is the second most critical element for life to exist. As a result, the scientific literature has numerous descriptions of water quality. It is the physical, chemical and biological characteristics of water, is the most frequently used definition of water quality. Water quality is a measurement of the state of water in relation to the needs of one or more biotic species and/or to any human need or purpose.

- One of the most crucial aspects of water quality is pH. It is described as the hydrogen ion concentration's negative logarithm. It is an arbitrary number that expresses how acidic or basic a solution is. Actually, water's pH is a gauge of how acidic or basic it is. Both basic and acidic water have more hydrogen (H+) and hydroxyl (OH) ions than usual.

- Total dissolved solids is referred to as TDS. It calculates the overall concentration of soluble salts and minerals in water. One mg/L of dissolved minerals, for instance, means that the water pitcher contains one mg/L of TDS.
- The salinity of a body of water, commonly known as saline water (also see soil salinity), is the degree to which salt is present. It is often measured in grams per litre (g/L).,Water that is cloudy is referred to as turbid. It gauges how well light can travel through water. It is brought on by particulate matter suspended in water, including clay, silt, organic matter, plankton and other particles.
- One of the most crucial indicators of the water quality in streams, rivers and lakes is dissolved oxygen (DO) which is regarded as one of the factors. It is an important indicator of water pollution. The water quality improves as the dissolved oxygen concentration does.

10.8. Standards for Physico-chemical properties of water

The water samples collected from various sources, i.e., RO water, tap water, bore well water, wastewater and treated water samples from the organization were subjected to analyze for its physico-chemical parameters by following the standard protocols. The results showed that all the water quality parameters were found to be appreciable and no harmful effect was recorded (Table 14). These water quality parameters were observed to be within the limit of Indian Standards of drinking water quality. The observed pH values were found to be 6.5 - 8.5 range. Similarly, observed TDS and salinity values were found to be 0 - 900 mg/L and 300 - 380 mg/L, respectively. Turbidity and dissolved oxygen were found to be 4.5 – 5.5 NTU and 6.5 - 8.0 mg/L; respectively in the test samples which are compliance with ISI standards. The fundamental characteristics of drinking water are very important because of large number of human population intervention, anthropogenic sources, municipal sewage disposal, solid / garbage waste disposal, industries activities and use of large number of vehicles and agrochemicals which will pollute the water quality at large.

Table 14. Physico-chemical properties of various water sources

S.No.	Water source	pH	TDS (mg/L)	Salinity (mg/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)
1.	RO Water	7.2	42.0	315.0	2.5	5.7
2.	Tap Water	7.9	177.0	356.0	3.8	6.5
3.	Well Water	7.8	285.7	364.0	4.0	7.1
4.	Pond water	7.7	248.7	382.0	5.7	7.3
Mean		7.65	188.35	354.25	4.00	6.65
SEC ±		0.13	46.50	12.27	0.57	0.31
CD at P = 0.05:		0.37	129.20	34.00	1.58	0.86

Source: IS 10500: 2012

Water analysis by using pH and TDS Meters

10.9. Water consumption rate

Since several variables are influenced water consumption by various stakeholders of an organization; it is hard enough to precisely assess the water quantity demanded by the public. Water is an immense requirement of any living organism. Though it is a natural resource,we are exploiting water for various purposes in day-to-day activities. As an educational institution, water requirement for various activities may differ as shown in (Table 15). Per capita Domestic Consumption in Hostels combined with Canteen ranges between 90 - 125 litres. Industrial or laboratory demand for water is estimated ranges between 100 - 300 litres. Losses as leakages and routine consumption accounts approximately 30 - 50 litres (per capita) and other uses daily usage uses accounts another 50 litres. Safe drinking water is a fundamental human right and if contaminated with opportunistic pathogenic environmental bacteria, it may have health implications for consumers. Human health should therefore be protected by preventing microbial contamination of water that is intended for consumption.

Table 15. Water consumption for various purposes

S. No.	Types of consumption	Normal range (L/capita/day)	Average
1.	Per capita domestic consumption at hostel and canteen of the organization	93-126	106
2.	Industrial and commercial demand at laboratories	124 - 255	178
3.	Public uses including fire demand and transport washes	2378-3345	2345
4.	Losses and waste as routine consumption in the organization	37-53	37
5.	Daily use (day-to-day use) in large by various stakeholders	64	35

11. WASTE MANAGEMENT AUDIT

11.1. Introduction

Waste management is a global environmental task but has always been neglected by the public. Improper waste management will create environmental issues *viz*., soil, water- and air-pollution which lead to health problems. Main reason for polluted environment is unawareness of consumers and improper or poor legitimate initiatives. Ever increasing population rate and the improved life style of the people results in generation of amplified amount of solid wastes, irrespective of urban and rural areas. Solid waste is defined as the unwanted substance which is generated by the society that does not have any economic value from the point of view of the user. Waste management is defined as the discipline associated with control of generation, storage, collection, transport/transfer, processing and disposal of solid waste materials in aesthetic way.

There is a daunting need of effective waste management in India as 62 million tons of municipal solid waste and 38 billion litres of sewage is generated annually only from urban areas. The solid waste increases at the rate of 1.0 - 1.3% annually and the maximum amount of municipal waste is left untreated (Rajalakshmi *et al*., 2023). Primary reason for unclean surroundings in the nation is unawareness of individuals, in general, deprived institutional initiatives. While educating the environmental health and security, it has to be initiate from grass root level, primarily, educational institutions are the right forum to start with. The waste management practices and strategic plan of waste management to material management, educational institutions should establish the physical facilities and follow the fundamental guidelines. The physical facilities established in the higher educational institutions and their utility through onsite auditing and to assess the implemented waste management practices with particular reference to recycling and generation of value added products.

11.2. Observations of the Waste Management Audit

- The institution has established vermicomposting and waste management practices within the campus, with opportunities for further enhancement through increasing vermicompost pits, improving composting support facilities such as leaf crushing systems, maintaining food waste records in the canteen, and ensuring proper disposal of unused chemical containers in designated areas.
- Solid wastes can be segregated at the source of generation by implementing the use of different coloured dustbins.
- The institution has provided incinerator facilities for napkin disposal, and periodic maintenance may be carried out to ensure proper functionality and efficient operation.
- Proper records of E-waste management should be maintained, covering collection, storage, and disposal through authorized agencies.
- Observed the allotment of separate team to perform environmental impact assessment and environmental management plan.

- The institution ensures proper handling and disposal of old or unused chemical containers by adopting safe and environmentally sound practices, particularly in areas such as near the greenhouse.
- Effective monitoring systems are encouraged in the canteen to maintain records of food waste generation, supporting better waste management and reduction strategies.

11.2.1. Technology Options (NBC Checkpoints 3.3 and 3.4.)

Traditional materials are used in the construction, environment friendly and cost-effective technologies are made available in the campus as per the building code.

11.2.2. Waste Management Practices (NBC Checkpoints 10.6, 10.7 and 12)

Waste Management has a common mandate that the 'Producer Owns the Responsibility'. The solid wastes are collected from different places of campus and segregated based on biodegradable and non-degradable materials subsequently subjected for recycling and degradation processes like composting. Details of the waste management practices in the Organization are 1) bio-degradable waste handling, 2) disposal of e-waste. Waste management is performed based on the waste management plan, separate committee is formed and monitored accordingly.

i) Solid waste management practices at the campus

The term, solid waste control refers to the method of accumulating and treating solid wastes by following ecofriendly methods. It is also a solution for recycling objects that do not belong to garbage. In the solid waste management, the wastes are accumulated from different parts and are disposed based on degradability materials like paper and non- degradability materials like glasses, plastics and metals. Organization has a very good solid waste recycling unit which operates a few vehicles to collect wastes using compostable bags across the campus. Both degradable and non-degradable items are being collected from canteens, stationary shops and hostels and disposed through the Corporation facility.

Vermicomposting practices is available in the campus

ii) Bio-degradable and non-degradable waste materials management practice

For segregation of waste (Organic, Recyclable, Non-recyclable and E-waste) at source and collecting the same 'Waste Bins' are placed at designated locations in the Campus *viz*. Students Hostels and Staff rooms, Students Service Centre, Sports

Complex and Guest rooms. A Contractor is engaged for the collection and further process of waste generated within the campus where biodegradable wastes subjected to preparation of organic compost.

Plastic waste bin observed in the campus

iii) Use of biofertilizers, organic and green manures

Natural or eco-friendly methods should be used to grow plants vigorously in the campus which could reduce the environmental pollution. The plant waste such as fallen leaves, stems, fruits, nuts, seeds and other plant parts are used to make green manures. Minimal use of chemical fertilizers as part of integrated nutrient management system is acceptable but 'zero use' of chemical fertilizers is highly appreciable. Bio fertilizers, farm yard manure and dried cow dung manure are extensively used in the audited organization to cultivate plants ensured to keep the campus organic. These practices are very well appreciated because air, water and soil pollution due to use of agrochemicals is eradicated which in turn to improve the soil health significantly.

Biogas Plant is available in the campus

iv) Disposal of E-Waste

According to E-Waste Management Rules, 2016 (Ministry of Environment, Forest and Climate Change, Government of India), electronic waste or e-waste includes old and non-functional electrical and electronic appliances. The e-waste materials were collected from the Organization are being segregated and then given to authorized

agencies for handling e-waste. Due to this e-waste activity disposal, the e-waste pollution is significantly reduced in the Campus. Organization has produced lesser quantity of e-waste and the same has been disposed through the Corporation facilities.

v) Construction waste and biomedical wastes management

The Ministry of Environment, Forest and Climate Change, Government of India has notified the Construction and Demolition Waste Management Rules, 2016 exclusively to manage waste (building materials, debris and rubble) from construction activities like new construction, re-modelling, repair and demolition. One of the best waste management practices is rebuilding of construction waste into pillars, pathway road and etc. The construction waste inside the campus is found to be very low. The Organization have taken pioneering efforts to dispose the hazardous as well as biomedical wastes properly that are generated from various Department laboratories. Most of the wastes are disposed of safely without affecting the environment, soil health and water quality as per the directions of World Hazardous Waste Programme.

vi) Recycling of wastewaters

The main feature of the treated water should not be harmful to the biodiversity, resources and the environment especially in soil ecosystem. If an industry or Organization has the wastewater treatment plan, proper records on the analysis of water input and output parameters including the running time of the wastewater treatment plant; its operation cost, its maintenance and the reuse records of the treated water should be well accounted.

12. CONCLUSION

Considering the fact that the organization is a well-established academic institution and there is significant scope for conserving air quality, carbon, environment, energy, fire safety, green, hygiene, soil, water and waste management, which in turn make the campus as self-sustained. The organization has taken enormous efforts to maintain green cum ecofriendly campus in a sustainable manner. It is observed that a large number of activities for the benefit of rural and tribal community people without disturbing the natural environment are being conducted. The installation of a rainwater harvesting system to conserve rainwater and improve the ground water levels are noteworthy. The Organization has created many types of ornamental garden, herbal gardens and green roof/greenhouse facilities at small scale level for establishing a massive reforestation / afforestation programme in which a large number of trees and shrubs species were planted together for providing an eco-friendly atmosphere to the stakeholders in a sustainable manner.

The energy conservation initiatives taken by the organization are substantial. Water and soil conservation activities are also implemented and practiced. Proper facilities and procedures are followed for waste collection, segregation, and disposal, recycle and reuse towards waste management initiatives. Quality of soil and water observed to be good. Hygienic and environmental practices are monitored and maintained considering the health and sustainability of the stakeholders at canteen and hostel premises. Tree plantations at appropriate locations are maintained to resist the indoor climate and conserve energy as per the National Building Code, Part - 11: Approach to Sustainability parameters which provide quality of air to the stakeholders. The organization has made significant progressive contributions with respect to teaching learning, research and consultancy, innovation and transfer of technology, community service and value education, in toto. It imparts quality education to rural, tribal and urban people across the nation which is excellent in terms of academic activities and providing an eco-friendly atmosphere to the stakeholders.

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