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WASTE MANAGEMENT

A Manual on
Waste Management Audit

Editors
Dr. S. Rajalakshmi
Dr. Amzad Basha Kolar
Dr. G.A. Asif Jamal

PRINCIPAL
Sri India College of Engineering and Technology
(Vill): SHERIGUDA-501 510,

Regd. No. 114/2017

NATURE SCIENCE FOUNDATION
No. 2669, LIG-II, Gandhi Managar, Peelamedu,
Coimbatore - 641 004, Tamil Nadu, India.
Phone: 0422 2510006, Mobile: 95667 77255, 95667 77258
Email: directornsf@gmail.com, director@nsfonline.org.in

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LIG-II, 2669, Gandhi Maanagar
Peelamedu, Coimbatore 641 004
Tamil Nadu, India

e-mail: directornsf@gmail.com; director@nsfonline.org.in
website: www.nsfonline.org.in

Phone: 0422-2510006
Mobile: 95667 77255; 95667 77258

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[illegible] College of Engineering and Technology

PREFACE

Waste Management and Soil and Water audit is the quantitative and qualitative data to track Soil, water and waste, and to gain actionable insights to improve the operational performance. It is used to maintain the clean and hygenic environment that leads to the stakeholders. It provides a solution at 360' view of a surrounding campus and makes it easy for Owners / Managers/ Environmentalists to collaborate, measure, control, and reduce environmental impacts. Finally it leads to enhancing the quality of life for human beings, animals and plants.

Waste Management Audits such as Bio – medical waste management, E- Waste Management, Plastic Waste Management and Soil and water audit are a well-developed process of extracting information about an Institution and Organization that provides a realistic assessment of how the Institutions and Organizations take steps towards protecting the environment. In order to save the ecofriendly atmosphere of an Institution and Organization, well-developed environmental objectives and targets should be undertaken to reduce the harmful effects to a greater extent. These audits can minimize the environmental pollution in the campus remarkably which in turn reduce the global warming effect as a whole. As per the Government law, the waste management legislations should be followed by all the Institutions and Organizations and make sure that their activities should not destroy the environment.

Nature Science Foundation (NSF), Coimbatore, Tamil Nadu, India is functioning energetically to conduct different awareness programmes and implement various schemes to Schools, Colleges and Universities across India towards the noble cause of environmental protection and nature conservation. The main motto of the NSF is "Save the Nature to save the Future" and "Go Green to save the Planet". NSF is a Non-Governmental ISO 9001:2015 certified organization under the Nature Science Foundation. Public Charitable Trust managed by a board of trustees. It is a non-profitable Foundation registered under the Societies registration Act 1975 (TN Act 27 of 1975).

The authors have taken enormous efforts to prepare this 'Environment Management Audit Manual' in a big way. Treatment of the subject matter has been very simple, clear and comprehensive. The authors followed lucid language with a maximum number of illustrations and photographs for easy understanding of the subject contents by the Readers. This manual will be definitely useful for the Lead Auditors those who are conducting audits on Environment Management perspectives. I express my sincere appreciation to all the authors in bringing out such a useful manual and took efforts in getting Copyright and publishing this Manual through a reputed publisher through proper channels.

CHAIRMAN
NATURE SCIENCE FOUNDATION
COIMBATORE, TAMIL NADU, INDIA

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...ndu College of Engineering and Technology
(Vill): SHERIGUDA-501 510,
...(M), R.R.Dist.

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Waste Management audit is a process to ensure that the waste are segregated and disposed safely without any harm to the environment and the living beings. Similar to that of Soil and Water audit is a type of assessment to ensure that the Institution and Organization campus is periodically checking the Water and Soil sample to ensure its quality level.

We attempted to prepare a comprehensive manual on 'Waste Management Audits' which covers Waste Management, Bio – medical waste management, plastic waste management and soil and water audit to Lead Auditors those who are conducting audits on Environment Management perspectives. Moreover, the authors did not claim that this is our own original ideas and concepts. It is merely an outcome of the compilation of different Waste Management System audit processes and collected more information from waste management legislations. It gives us an immense pleasure to thank Nature Science Foundation, Coimbatore, Tamil Nadu, India for offering an opportunity to write a comprehensive manual on 'Waste Management Audits' which is copyrighted and published through proper channels.

Words are inadequate to express my sincere thanks to Chairman, Vice-Chairman, Secretary, Joint Secretary, Treasurer, **Dr. P.V. Sreenivasan**, Director, Dr. Sreekala K Nair, Director (R&D), **Dr. D. Vinoth Kumar**, Joint Director, **Ms. V. Sri Santhya**, Programme officer, **Ms. T. Joys Ememmal**, Programme Officer, **Ms. M. Nithya**, Programme officer, **Ms. E. Sivaranjani**, Programme Officer, **Ms. R. S. Thulaja**, Programme Officer and **Ms. S. Vishnu Swetha**, Programme Assistant for their constant encouragement and support in writing this manual very successfully.

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Dr. S. Rajalakshmi
Dr. Amzad Basha Kolar
Dr. G. A. Asif Jamal

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Sri Indu College of Engineering and Technology
(VIII): SHERIGUDA-501 510,
Ibrahimpatnam(M), R.R.Dist.

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Sri Vidya College of Engineering and Technology
(Vill: SHERAGUDA-501 510,
Batasingaram (M), R.R.Dist.

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Sri Indu College of Engineering and Technology
(Vill: SHERIGUDA-501 510,
Ibrahimpatnam(M), R.R.Dist.

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Sri Indu College of Engineering and Technology
(VIII), SHERIGUDA-501 510,
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Sri Indu College of Engineering and Technology
(VIB): SHERIGUDA-501 510,
Ibrahimpatnam(M), R.R.Dist.

1. WASTE MANAGEMENT AUDIT

1.1. Introduction

Due to the increasing population and subsequent urbanization, production and consumption processes have increased because of which waste generation has increased rapidly in India. As a result of industrialization and the shifting of people from rural to urban areas in search of jobs, there has been an increase in the urban population, as a result of which waste generation has also increased tremendously. Industrialization has brought both positive as well as negative impacts on the world. And, solid waste generation and its improper management is one of the negative consequences of industrialization. Unscientifically, disposal of solid waste in open dumps and landfills creates problems for public health and the environment. Hence, safe disposal with effective waste management is necessary. Waste management is concerned with how solid waste can be transformed and turned into a useful resource. Currently, India's population is around 1.40 billion, or 140 crores, which is showing an increase of 0.91 billion during 2011. In 2011, India's population was 1.21 billion (UIDAI, 2020). As per an estimate, a total of 1,30,000 to 1,50,000 metric tonnes (MT) of municipal solid waste is being generated in India every day. That means around 330-550 grammes of waste is generated per urban inhabitant per day. In this way, it adds up to roughly 50 million MT per year, and if it is calculated considering the current rates, this will increase to ~125 million MT per year by 2031 (Atin Biswas, Subhasish Parida et al. 2021).

Solid waste is a mixture of biodegradable, non-biodegradable, recyclable, and inert waste generated primarily from residential, commercial, industrial, and institutional sources. As per a recently published study, around 62 million tonnes of waste are currently being generated in our country, which may increase by up to 165 million tonnes by 2030 (Tewari, 2021). Of the total generated solid waste, only 75-80% of the municipal waste gets collected and only 22–28% of this waste is processed and treated (PIB GoI, 2016). So, the rest of the waste (approx. 72–78%) is left untreated and dumped in open areas, which is leading to environmental and health hazards. Therefore, it is necessary that every household, including business owners all around the world, adopt solid waste management.

1.2. What is waste?

Waste is a discarded substance that cannot be used further by the primary user or that is no longer used for its intended purpose. Generally, waste, commonly known as garbage, is generated due to human activities from domestic activities, commercial activities, construction activities, or industrial activities. All non-biodegradable parts of these waste products which are added to the environment are often highly resilient and remain for very long periods of time in the environment without decomposition.

1.3. Categories of Waste

There are broadly two categories of wastes, viz., biodegradable and non-biodegradable waste. Biodegradable wastes, also known as wet waste, are the waste types that are mainly of plant and animal origins and include domestic waste such as food waste generated from the kitchen, garden waste or green waste, paper waste, and biodegradable plastic waste. These wastes are decomposed by the microbes over time depending on the material and can be composted to obtain manure. Human waste, sewage, and slaughterhouse waste also come under biodegradable waste. Generally, the biodegradable portion is mainly due to food and garden waste.

Non-biodegradable waste is also called dry waste. It cannot be degraded by microorganisms, so they remain on the earth as it is for thousands of years. Hence, they are the major pollutants. It includes glass, plastics, newspaper, etc. Though it cannot be decomposed, it can be recycled and reused. It is a heterogeneous mixture consisting of paper, plastic, cloth, metal, glass, earth, construction and demolition materials, organic matter, household waste, sanitation residue, and waste from streets, etc. Hence, apart from biodegradable and non-biodegradable waste, a few other categories are there.

All the five broad categories of waste are as follows:

- **Biodegradable waste:** food and kitchen waste, green waste, paper (can also be recycled).
- **Non-biodegradable/ recyclable material:** paper, glass, bottles, cans, metals, certain plastics, etc.
- **Inert waste:** construction and demolition waste, dirt, rocks, and debris.
- **Composite wastes:** waste clothing, Tetra Packs, waste plastics such as toys.
- **Domestic hazardous waste and toxic waste**: It is also called household hazardous waste. These are: medication, e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, batteries, shoe polish, etc.

1.4. Types of Waste

There are types of waste that are described as follows:

1.4.1. Municipal Solid Waste: Municipal solid waste (MSW), commonly known as garbage, is collected by the municipality and/or disposed of at the municipal waste disposal site. Based on the sources of waste generation, it is further categorised into residential, commercial, institutional, and municipal services. Municipal solid waste (MSW) consists of the items that are used in our daily lives and then thrown away. These products include food items, packaging materials, newspapers, clothes, containers, bottles, batteries, and durable goods like furniture, etc., generated by households, offices, hotels, shops, schools, and other institutions. The major components are paper (27%), food waste (14.6%), yard trimmings (13.5%), plastic (12.8%), rags, metal (9.1%), rubber, leather, and textiles (9%), wood (6.2%), and glass (4.2%) (USEPA, 2013). Some fractions of demolition and construction debris, hazardous waste materials such as used electric light bulbs, batteries, automotive parts, and a very small quantity of biomedical waste such as discarded medicines and used syringes, are often found in collected municipal solid waste. Once collected, they are sorted and treated for recycling and reuse before their final disposal.

1.4.2. Biomedical waste: Biomedical waste or hospital waste is the waste created by healthcare activities such as diagnosis, treatment, immunization, or any kind of research activity or in the production or testing of biologicals. It contains hazardous materials such as needles and syringes, chemicals, pharmaceuticals, medical devices, and radioactive materials and infectious materials such as unwanted microbiological cultures and stocks, bandages and soiled dressings, body parts, other human or animal tissue, diagnostic samples, discarded blood, etc.

1.4.3. Plastic waste: Plastic wastes are the discarded products made of plastic, such as packaging material, carry bags, pouches, etc. whose life is over and are of no use as prescribed in the Plastic Waste Management Rules, 2016. They are recyclable materials. It is necessary to manage plastic waste properly because the accumulation of plastic discarded objects causes adverse effects on wildlife, the marine environment, and human beings.

Plastic waste can be easily seen everywhere on land and in oceans, lakes, rivers, ice, and air, which causes damage to humans and the whole environment.

1.4.4. Electronic waste: Electronic waste, also known as "E-waste," refers to unwanted or useless electronic or electrical products that are non-working, broken, rejected, or have reached the end of their useful life. Some examples of electronic waste are computers, cell phones, tablets, televisions, photocopiers, fax machines, etc. They are dangerous in nature due to toxic chemicals they release and can harm the environment. Although they can be refurbished, reused, or recycled.

1.4.5. Bio-waste: Bio-waste is biodegradable waste, which consists of mainly organic waste. It includes green waste generated from paper waste, gardens and parks, food and kitchen waste from households, restaurants, and food processing waste from food processing plants. In the landfill directives, it is defined as 'waste capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and cardboard. Bio-waste is a fuel resource that may be used to produce heat and electricity.

1.4.6. Construction and demolition waste: C&D waste comprising of building materials, construction debris and rubble generated during the redevelopment, construction, repair and demolition of any civil structure. Though it is kept as a separate category, some of the fraction of C&D waste is also found in municipal solid waste. Earlier, the waste was disposed of at the disposal facilities. But nowadays, in some cities, C&D waste treatment facilities are available. C&D waste contains high proportion of recyclable materials, which are used to make construction materials. There may be some hazardous substances in C&D waste, and those should be disposed of separately.

1.4.7. Industrial waste: Industrial waste is generated as a result of industrial processes. They are categorized mainly as hazardous waste and non-hazardous waste. Though industrial waste is not considered as municipal solid waste and is not mixed with it, in some places, non-hazardous waste is disposed of with municipal waste. In this case, the industries arrange for waste transportation to the disposal site and may be responsible for disposal fees. According to the legislation and current practises, the municipality should explicitly define its responsibility for industrial waste management. This would assist in the quantity and classification of hazardous and non-hazardous industrial wastes, as well as municipal and non-municipal wastes.

1.5. Solid Waste Management

Different kinds of waste have various environmental impacts. Improper or unscientific disposal of solid waste causes health hazards, disease, water contamination, air pollution, and bad aesthetics, etc. Solid Waste Management refers to the management of solid waste generation, collection, storage, transfer, transport, processing, and disposal in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental issues. It provides solutions for reuse and recycling items to save resources. Solid waste management includes the processes and actions required to manage waste from its generation to final disposal, which is collected from different sources and disposed of properly. The scope of waste management includes all administrative, financial, legal, planning, and engineering tasks associated with the solutions to problems of the solid waste challenges that the community's residents have imposed on it (Tchobanaglous, *et al.*, 1997).

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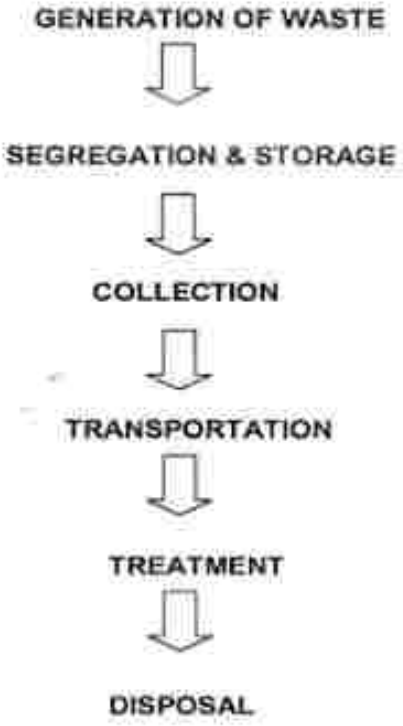

Figure 1. General process of Waste Management

1.6. Segregation and Storage of MSW

SW is usually collected and stored at source and then segregated into biodegradable waste and non-biodegradable waste. The non-biodegradable waste is thereafter segregated into recyclables, non-recyclables, and hazardous waste. After segregation, waste is stored in waste bins.

Colour Coded Bins in Urban Areas	Colour Coded Bins in Rural Areas

1.6.1. Collection

Collection of waste takes place on a daily basis in all departments. The common areas are swept and the waste is transported to the collection centres.

1.6.2. Transportation

From the collection centres, waste is transported to the treatment or disposal/ landfill site. Tractor-trailers, tricycles, etc. are mainly used for the transportation of this waste.

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1.6.3. Treatment

There are two main mechanisms of waste treatment being adopted in India. These include composting (aerobic composting and vermicomposting) and waste-to-energy (WTE) (incineration and pelletisation).

1.6.4. Disposal on Dumping/ Landfill Sites

A landfill, or a "dump site," is a site where waste materials are disposed of. Historically, landfills have been one of the most common methods of waste management and remain so in many places around the world. Landfills are the waste disposal sites used by numerous producers as well as internal waste disposal facilities (where a producer of waste disposes of its own waste at the place of production). Many landfills are also used for other waste management purposes, such as temporary storage, consolidation and transfer, or, in most cases, permanent disposal. Landfill sites can be classified into various categories, like sanitary landfills, hazardous waste landfills, inert waste landfills, dumps, and bioreactor landfills.

1.7. Waste Management Legislations

1.7.1. Waste management Legislations

Due to the rapid industrialization and development in the country, the generation of waste has increased manifolds. Sometimes this waste is not regulated and managed properly, which creates various environmental as well as health issues. Hence, to ensure development and sustainability go together, it is necessary that waste be properly treated and disposed of. In India, the Ministry of Environment, Forests and Climate Change (MoEFCC) is the governing body which works with the Central Pollution Control Board (CPCB) and other State Pollution Control Boards (SPCBs). There are several policies, acts and rules are available for the purpose of waste regulation which help in waste management.

These policies, acts and rules aim to reduce the generation of waste, encourage waste recycling, and eliminate unregulated waste disposal into the environment, which might affect the ecosystem or human beings.

1.7.2. The National Environment Policy

The National Environment Policy, 2006 laid emphasis on disposal, recycling and treatment of waste.

1.7.3. The Environmental Protection Act

The Environment Protection Act was enforced in 1986 in India for the protection and improvement of the environment. The act aims to support and promote the management, protection, enhancement, and wise use of the environment, while recognising the following: Preventing, mitigating and remediating environmental impacts is important in making decisions and taking actions.

The rules framed under the Act mandate industrial units and corporates to act in a responsible manner to protect the environment, ensure the location and functioning of industries and deal with waste generation in a responsible manner. Various rules are notified to govern areas like waste prevention, minimization, reuse, and recycling of municipal solid waste, industrial, agricultural, and hazardous waste.

This Act confers powers on the Central Government to regulate all forms of waste. It is one of the primary legislatures to protect the environment and regulate waste. Some of the important provisions of this Act are as follows:

1. Section 7 of this Act places a principal prohibition on harming the environment by stating that no person carrying out any activity should emit or discharge environmental pollutants in excess of the prescribed standards.
2. Section 9 of the Act states that if any event takes place which harms the environment through any foreseen or unforeseen event, the person responsible for the harm is duty bound to prevent or alleviate the pollutant discharged as a result of such event. The person is also obliged to inform the proper authorities about any event that may harm the environment.
***Polluter Pays Principle**– Section 9(3) of the Act embodies the "Polluter Pays Principle" which states that any expense which has been incurred to restore the environment to its natural state shall be paid by the person who is responsible for such degradation. This concept of continuing punishment is very important.
1.The Act also contains provisions which remove the corporate veil. In the event that any environmental offence is committed by a company, with the connivance or consent of any director, manager, secretary, or any other officer of the company, they'll be held personally liable for committing offences in the name of the company.
2. Environmental Protection Rules, 1986 were formulated by the government under the power conferred to them by the Environmental Protection Act. Through these powers, the government has the authority to give specific directions, without changing the principle Act.

1.7.4 Sold Waste Management Rules, 2016

The Ministry of Environment, Forest and Climate Change, Government of India has revamped the Municipal Solid Wastes (Management and Handling) Rules 2000 and notified the new Solid Waste Management Rules, 2016 on April 8, 2016. Every urban local body (from Mega City to Panchayat level), outgrowths in urban agglomerations, census towns as declared by the Registrar General and Census Commissioner of India, notified areas, notified industrial townships, areas under the control of Indian Railways, airports, airbases, defence establishments, special economic zones (SEZs), state and central government organizations, places of pilgrimage, religious and historical significance as may be notified by the respective authorities household, event organizers, street vendors, RWAs & Market Associations, gated communities having more than an area of 5000 sq.m., hotels & restaurants, etc.
In the rules, the duties of waste generators and authorities are described. It is the duty of each waste generator to segregate waste category wise (bio-degradable, non-biodegradable, and domestic hazardous wastes) and store waste separately in suitable bins and hand it over to municipal workers or authorised waste collectors. Construction and demolition waste, sanitary waste, and garden waste should be stored properly and disposed of as per the guidelines. No waste generator shall dump, burn, or bury solid waste generated outside his premises on streets, public open spaces, or in drains or bodies of water. All waste generators are required to pay a user fee. No one shall organise an event or gathering of more than one hundred people in any unlicensed location without notifying the local body at least three working days in advance – they are responsible for waste segregation. Within one year of the date of notification of these rules, all resident welfare and market associations; all gated communities and institutions with more than 5,000 sqm of area; and all hotels and restaurants must segregate waste in partnership with the local body, treat waste by composting or bio-methanation, and hand over recyclables to authorised recyclers.

1.7.5 Hazardous and Other wastes (Management and Transboundary Movement) Rules, 2016

The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, were published to ensure the safe generation, processing, treatment,

packaging, storage, transportation, use reprocessing, collection, conversion, and offering for sale, destruction, and disposal of hazardous waste.

The HWM Rules, 2016 ensure resource recovery and disposal of hazardous waste in an environmentally sound manner. Unlike HWM rules 2008, rules 2016 also talk about other wastes, which means Waste tyres, paper waste, metal scrap, used electronic items, and other materials are recognised as recyclable and reusable. These resources support industrial activities while also reducing the country's reliance on its natural resources. HWM rules for 2016 include 6 chapters, 8 schedules, and 12 forms. These rules are not applicable to wastewater, exhaust gases, radioactive wastes, biomedical wastes, or municipal solid wastes. HWM Rules define

- Responsibility of the occupier for hazardous waste management
- Responsibility of the State Government
- The import and export of hazardous and non-hazardous wastes
- The process of their treatment, storage, and disposal
- process of packaging, labelling, and transportation

1.7.6 The Plastic Waste Rules, 2016

The Plastic Waste Management Rules, 2016 were notified on March 18, 2016 in the Official Gazette by the Ministry of Environment, Forests and Climate Change, under sections 6, 8 and 25 of the Environment Protection Act. The rules are aimed

- To push waste minimization,
- It enables and ensures source segregation and recycling,
- Encourage waste pickers, recyclers, and waste processors to participate in the collection of plastic waste fractions from households or any other source of its generation or intermediate material recovery facility.
- To adopt the polluter's pay principle for the sustainability of the waste management system
- To ensure effective plastic waste management so as to minimise the threat posed to the environment.

Plastic waste rules, 2016 have been made applicable to every waste generator, local body, gram panchayat (rural regions), manufacturer, producer, and importer. The rules are not applicable to Special Economic Zones (SEZs) or export-oriented units. PW rules include 1 schedule, 17 rules, and 6 forms. In the rules, the responsibilities of every producer and generator are described. Principal responsibilities include:

- To ensure that recyclable plastic waste fractions are separated, collected, stored, transported, and channelled to authorised recyclers
- To ensure that recyclable plastic waste fractions are channelled to recyclers
- Ensuring that no damage is caused to the environment during this process.
- Creating awareness among all stakeholders about their responsibilities
- Ensuring that plastic waste is not burnt openly.

1.7.7. Bio-Medical Waste Rules, 2016

There may be several risks, such as disease or infection due to untreated bio-medical waste, risk of disease due to use of expired medicines, and risks to domestic and stray animals from improper bio-medical waste management. Biomedical waste management rules ensure the proper disposal and management of biomedical waste. The Bio-Medical Waste Management Rules, 2016 apply to all the wastes generated during the diagnosis, treatment, or immunisation of human beings, animals, research activities pertaining thereto, or in the production or testing of biological products, or in health camps and the categories

mentioned in Schedule-I of the rules. Rules are aimed at ensuring the safe disposal of bio-medical waste. The BMW Rules 2016 have the main features of the Bio-medical Waste (Management & Handling) Rules, 1998 as well as several new provisions. The new rules contain 4 schedules, 18 rules, and 5 forms. These regulations apply to all units that generate bio-medical waste, including hospitals, nursing homes, clinics, dispensaries, Ayush hospitals, pathological laboratories, blood banks, veterinary institutions, animal houses, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, school first aid rooms, forensic laboratories, research labs, and so on. Each occupier of a bio-medical waste generating unit needs to obtain an authorization from the concerned State Pollution Control Board (SPCB). The bio-medical waste management process involves:

- ✓ Bio-medical waste should be separated at the point of generation.
- ✓ Highly infectious and laboratory waste should be pre-treated.
- ✓ Colour-coded containers/bags/bins should be used for collection and storage of segregated waste.
- ✓ Wastes are transported from the source to a central storage area and stored there and treated.
- ✓ Finally, waste is disposed of through the Central Bio- Medical Waste Treatment Facility.

1.7.8. E-Waste Management Rules, 2016

The E-Waste (Management) Rules were notified on March 23rd, 2016 and came into effect on October 1st, 2016 by the Union government to update existing waste management norms in India. The E-waste management rules 2016 are applicable to every producer, consumer or bulk consumer, collection centre, dismantler, and recycler of e-waste involved in the manufacture, sale, purchase, and processing of electrical and electronic equipment or components listed in Schedule I, including their components, consumables, parts, and spares, which make the product operational. The rules have obligated various stakeholders to perform important duties under the rules so as to ensure proper and effective management and disposal of e-waste.

Schedule I of the EWM Rules 2016 has two categories of electrical and electronic equipment, namely:

- ✓ Computers, main frames, minicomputers, notebooks, notepads, laptops, personal computers, printers including cartridges, copying machines, electronic typewriters, telephones, mobiles, cordless telephones, answering machines.
- ✓ Consumer electricals and electronics like TVs, washing machines, refrigerators, air conditioners, including other mercury-containing lamps.

Some of the important feature of EWM rules 2016 are:

- ✓ The EWM rules 2016 have extended the applicability to manufacturers, dealers, refurbishers, etc.
- ✓ Used lead acid batteries and radioactive waste are excluded from EWM 2016
- ✓ Micro enterprises have specifically been excluded from the purview of applicability of the EWM Rules, 2016.
- ✓ Another main feature of these rules is Extended Producer Responsibility (EPR), which is the responsibility of every producer of electrical and electronic equipment (EEE) for the channelization of e-waste to an authorised dismantler or recycler to ensure environmentally sound management of such waste. EPR authorisation is mandatory and all the producers, including importers, e-retailers, on-line sellers and e-bay of EEE covered in the E-Waste (Management) Rules, have to obtain the same.

1.7.9. Batteries (Management and Handling) Rules

As batteries include dangerous and corrosive compounds such as mercury, lead, cadmium, sulphuric acid, lthium perchlorate, and others, batteries management and handling rules were developed to ensure that they were properly disposed of. Every manufacturer, importer, re-conditioner, assembler, dealer, recycler, auctioneer, consumer, and bulk consumer who is involved in the manufacture, processing, sale, purchase, and usage of batteries or components is subject to the rules.

- By the 30th of June and 31st of December of each year, the manufacturer, importer, assembler, and re-conditioner must submit to the SPCB a half-yearly return of their sales and buy-backs in Form-I.
- Both the importer and the recycler must register.

1.7.10. Construction and Demolition Waste Management Rules, 2016

The construction and demolition (C&D) waste management guidelines were implemented to encourage the use of C&D waste as well as segregation, recovery, reuse, and recycling at the source of origin. The rules apply to all waste generated during the construction, remodelling, repair, or demolition of any civil structure by any individual, organisation, or authority that generates construction and demolition waste, such as construction debris, etc.

Main compliances under the C&D waste management rules are as follows:

- The State Pollution Control Board or Pollution Control Committee must be notified of the authorization for the construction of a site for storage and processing, recycling facilities, or construction and demolition waste on Form I.
- If an accident occurs during the processing, treatment, or disposal of construction and demolition waste, the local authority's official in charge of the facility or the facility's operator must notify the local authority on Form-V.

1.8. Waste Management Audit

1.8.1. Waste Management Audit

A waste audit, also known as a waste composition analysis, is a physical and systematic analysis of all the waste available at a waste generating unit. The detailed survey and analysis are conducted by the auditor to get a detailed understanding of waste generation, waste composition, and waste categorization, which helps in understanding the problems and identifying the potential opportunities. A waste audit also helps ascertain the cost incurred for waste disposal and how it can be reduced through reusing or recycling the waste.

A waste audit is proposed and carried out to ensure that waste management techniques are implemented and followed in a sustainable manner in organisations, institutions, and the industrial sector. The audit process includes the preparation and completion of a questionnaire, a physical investigation of the campus, observation and study of documents, key person interviews, data analysis, measurements, and recommendations. During the waste management audit, the following points are addressed: waste generation, storage of waste, and waste disposal. An auditor helps to identify the waste generation by going through the waste containers, sorting waste items, making observations, recording, and analysing the data. A waste audit includes the following tasks:

- Establish baseline data.
- Identifying and quantifying waste streams.
- Examine waste flow paths.

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- To identify opportunities for waste diversion and source reduction.
- Evaluate the performance of present waste management systems.
- Identify strategies to improve their efficacy.
- Obtain detailed waste generation data.

1.8.2. Significance of Waste Audit

A waste audit can help the organisation be better equipped to dispose of the garbage it produces on a daily basis in an effective and responsible manner. By carrying out a waste audit, it can be ascertained what kind of waste is being generated and how much of each type of waste is generated. Sorting and weighing of the waste materials gives a clear picture of the types and quantity of waste materials. Once the type and quantity of waste material being generated every day is known through a waste audit, a more efficient waste management plan can be designed for the organisation, so that proper initiative can be taken for the reuse and recycling of the waste materials.

A waste audit also provides insight into how effective the organization's current waste management system is; what the problems, ambiguities, and breakdowns are, and what changes and adjustments can be made to make it better and more efficient.
Conducting a waste audit in organisations or waste-generating units is important because it serves as a key to the identification, assessment, and quality improvement processes and helps to achieve the desired outcomes, such as cost reduction, compliance, and increased sustainability.

1.8.3. Objectives of Waste Audit

The objectives of the audit will determine the waste types, characteristics, and physical locations to be audited. The main objectives of audit objectives are:

- To determine the composition and quantity of waste being generated,
- To encourage the reuse and recycling of materials to minimise the waste thrown away in trash.
- To ensure the proper waste management practises are being implemented and followed.
- To measure the effectiveness of existing waste management systems.
- To identify opportunities for improving waste management systems and strategies.
- To collect baseline data for measuring the effectiveness of waste minimization strategies.
- To ensure that the waste arising from work is handled, stored, collected, transported, and disposed of in an environmentally acceptable manner.

1.8.4. Benefits of Waste Audit

Conducting waste audits can help minimise an organization's negative environmental impact so that the most suitable waste disposal alternative can be selected. Here are a few ways a waste audit might help an organisation or institute make innovative changes:
1. The waste audit provides all the information on storage, collection, disposal, and transportation of waste. This data helps to determine the effectiveness of the operation of the organisation. It gives an idea about what is working or not working with the existing waste and recycling management program. Hence, it enables organisations to figure out the most effective and sustainable waste management policy. This allows you to make the necessary changes to increase and maximise your operating efficiency. If an auditor finds during the auditing process, that more recyclables are being thrown away in the trash, in

that case, corrective action can be taken by fine-tuning the recycling programme or educating employees about recycling and repurposing of waste.

2. Through a waste audit, the progress and success of operations can be measured by setting a baseline and creating benchmarks year after year. Suppose the percentage of recyclables is around 20%, and later, in a follow-up waste audit a year later, it is observed that recyclable content in waste has dropped to 15%. It means that the waste management procedures are successful. Targets can be set and the progress and effectiveness of the waste and recycling programmes can be measured.

3. Waste audits are an important way to save money by minimising waste generation, increasing reuse and recycling, and sending the least amount of waste to the trash. Waste hauling can also be reduced if it is properly managed. Some hidden revenue may even be generated from the generated recyclable waste and composting.

4. Through a waste audit, data can be checked and verified against that provided by the hauler, and you will get more accurate data. In this way, it helps to cut the hauling costs and save money by paying unnecessary fees levied due to incorrect data.

5. With accurate waste data, strategies can be put in place to reduce the volume and/or frequency of solid waste disposal and hauling costs.

6. The waste audit helps to meet the standard requirements as they are part of the various certification systems like LEED, IGBC, GRIHA, and GEMS etc.

7. There are certain guidelines and rules under the legal setup for every business who disposes of waste. Every business can get the actual data by conducting a waste audit wherein a comparison of the current operations and regulatory requirements is made. Therefore, expensive fines can be avoided.

8. It gives calmness and peace of mind when you know that your organisation is meeting legal disposal requirements.

9. Waste audits help to determine the waste category and estimate waste quantity, and further design a more efficient waste disposal programme for reuse and recycling of waste that diverts useful material from the landfill. It helps to reduce air and water pollution, which helps curb global warming and conserve natural resources.

10. Through waste audit, an organisation gets the recognition of being an eco-friendly organisation because of the adoption of an eco-friendly management system. This helps to attract customers in the future.

1.8.5. Checklist for Waste Audit

The checklists for the conduct of a waste audit have been included with different parameters on waste collection, storage, and disposal. An adequate number of colour coded dustbins as per guidelines (Red, Yellow, Blue, and Black & Green Bins) should be made available on the campus for various waste collection, segregation, and disposal activites. A waste disposal record register, as well as puncture-proof containers for sharps and blue bags, should be kept and made available on campus.

In hospitals, labs, and pharmaceutical industries, mutilators such as needle/syringe cutters and calibrated weighing machines for biomedical waste collection should be made available. Personal protective equipment such as gloves, caps, masks, aprons, gumboots, and so on should be readily available on campus in accordance with campus policies. Around 1% fresh sodium hypochlorite or bleaching powder solution should be made available as per guidelines in hospitals, labs, and pharmaceutical industries. In addition, the Mercury Spill Management Kit, Post Exposure Prophylaxis Kit, and Blood Spill Management Kit should be made available in hospitals, labs, and pharmaceutical industries. There should be proof of a licenced company's' signed MoU with the organisation for waste collection as per the Govt. regulation available at waste generating unit. Norms must be followed by the organisation as per the Central and State Government Pollution Control

Board. Different forms, formats, annual reports, etc. should be made available for waste collection and mode of transportation. A trained, dedicated, and skilled individual for waste management should be present at the waste generating unit. The waste must be segregated at the site of generation. If the waste is not segregated, then the reason should be known. It should be ensured that infectious and non-infectious waste should not be mixed at the source of generation in hospitals, labs, and the pharmaceutical industry.

To determine the E-wastes, wood wastes, construction wastes, plastic wastes, hazardous wastes, and biomedical wastes should not be mixed at the source of generation. Bins, containers, and bags and their transportation means should be monitored. Details on the personal protective equipment like masks and gloves used while collecting the waste from the site of deposition should be made available. Proper details of the adoption of E-waste management and plastic waste management in the campus are to be checked.

In order to determine the quality practises undertaken by any organisation or waste generating unit and to recommend more convenient strategies to eradicate contaminants coming from the waste, waste auditors follow a set of predetermined checklists. For organisations like educational institutions and industries, the following are the checklists:

I. Qualitative Measurement of Waste Management

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	Remar
1.	Adequate number of Dust Bins as per Guidelines (Red, Yellow, Blue, and Black & Green Bins) are made available in the campus for various wastes, collection, segregation and disposal.			
2.	Record Register for waste disposal and Puncture proof Containers for Sharps / Blue Bags are made available in the campus			
3.	Mutilators (Needle / syringe cutters) and calibrated weighing machines for biomedical wastes collection*			
4.	Personal protected materials like Gloves, Caps, Masks, Aprons & Gum boots etc. used are adequately made available as per the Guidelines in the campus.			
5.	Around 1% fresh Sodium hypochlorite or Bleaching Powder solution is made available as per guidelines*			
6.	Mercury Spill Management, kit, Post Exposure Prophylaxis Kit and Blood spill Management kit are available*			
7.	Proof of Licensed Companies signed MoU with the Organization for wastes collection as per the Govt. regulation			
8.	Norms are being followed by the Organization as per the Central and State Government Pollution Control Board			
9.	Different Forms, Formats, Annual Report, etc. are available for waste collection and mode of transportation			
10.	Availability of a trained dedicated with skilled personals for waste management.			
11.	Is the waste segregated at the site of generation? If not, where are they segregated?			

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12.	Is the infectious waste and non infectious waste mixed at the source of generation?*			
13.	Is e-wastes, wood wastes, construction wastes, plastic wastes, hazardous wastes and biomedical wastes mixed at the source of generation?			
14.	Is the waste covered in covered bins? and Is the bins filled up to more than ¾ th level ?			
15.	Is the bins cleaned with soap and disinfectant regularly and bins are overfilled? And is the stored waste kept beyond 48-72 hrs?*			
16.	Is the waste transported in closed containers or open bags? and Are the waste collection bins/Trolleys/wheel barrow used for transporting wastes?			
17.	Is the personal protective gears like mask and gloves used while collecting the wastes from the site of deposition?			
18.	Whether the concept of E-Waste management is followed in the campus?			
19.	Has a Management Representative, E-Waste Specialist, Laboratory Staff been assigned?			
20.	Whether E-Waste management practices included in the purchase policy of electronic items?			
21.	Whether an authorised refurbrisher appointed to manage the E-waste			
22.	Are the E-Waste refurbished and used again in the Institution?			
23.	Whether the importance waste and their implications on environmental and personal hygiene through awareness programmes are conducted for stakeholders?			
24.	Signing MOU with Government and NGOs ensure proper handling of waste materials			
25.	Whether construction and wood wastes are subjected to reuse them in the same organization campus?			
26.	Whether plastic wastes are burnt inside the campus? Any air pollution due to plastic materials burning takes place ?			
27.	Projects and dissertation works, scholarly publication on various wastes and their management carried out by staff members and students			
28.	Whether hazardous wastes are properly discarded in which acids, solvents and salts are disposed after diluting with water and poured after buried in the soil			
29.	Have programmes for the achievement of plastic free area objectives and targets been established and implemented as on today? Any display board is made in the campus?			
30.	Are recycling of plastic polymers promoted in the campus among the stakeholders?			
31.	Wood waste are collected and recycled properly and they used for fuel and degradation / green manuring purposes?			

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32.	Residual wastes are properly disposed in the campus after burring the soil with proper dilution with water			

*Applicable for Hospitals/Labs/Pharmaceutical Industrial sectors

II. Quantitative Measurements

S.No	Name of the Electrical items / Equipment / Instruments	E waste code by NSF	Quantity
1.	Mainframe	ITEW	
2.	Internet connectivity Accessories	ITEW	
3.	Personal computer	ITEW	
4.	Laptop	ITEW	
5.	Dot matrix Printer	ITEW	
	Laser Printer	ITEW	
	Ink jet printer	ITEW	
6.	Cartridge	ITEW	
7.	Xerox machine	ITEW	
	Scanner	ITEW	
	Fax machine	ITEW	
8.	Telephones	ITEW	
9.	Cellar phones	ITEW	
10.	Television	CEEW	
11.	Solar panel	CEEW	
12.	Water heater	CEEW	
	Solar water heater	CEEW	
13.	Split AC	CEEW	
	Window AC	CEEW	
	Centralized AC	CEEW	
	Air Cooler	CEEW	
14.	Tube light	CEEW	
	Fluorescent lamps	CEEW	
	Halogen lamp	CEEW	
	Sodium Vapour lamp	CEEW	
	CFL	CEEW	
	LED tube lights	CEEW	
	LED Focusing lights	CEEW	
15.	Ceiling Fan	CEEW	
	Pedestal Fan	CEEW	
	Table Fan	CEEW	
	Portable Fan	CEEW	
16.	Lead acid batteries	CEHW	
17.	Lithium Ion Battery	CEHW	
18.	Cable and wires	CEEW	
19.	Inverter with UPS	CEEW	
20.	Switch board	CEEW	
21.	Solar panel	CEEW	
22.	LCD projector	CEEW	
23.	Refrigerator	CEEW	

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24.	Water doctor	CEEW	
25.	RO water plant	CEEW	
26.	Generator	CEEW	
27.	Pump	CEEW	
28.	Motors	CEEW	
29.	Compressor	CEEW	
30.	Vacuum Cleaner	CEEW	
31.	Ventilator	CEEW	
32.	Insect trap	CEEW	
33.	Podium containing Mike, Speakers, Amplifiers, Radio, Camera, Sensors, etc.	CEEW	
34.	**Civil Engineering Equipment / Machines** Compressing testing machine, Universal testing machine, Total Station, Theodolites, Flexure testing machine, Torsion testing & Izod impact testing machines, Hardness testing machine, Beam deflection test apparatus, Centrifugal Pump, Gear Pump, Submersible pump, Reciprocating Pump, Pelton Wheel turbine, Francis turbines / Kaplon turbine, Turbidity meter, pH meter, Conductivity meter, Jar test apparatus, BOD incubator, COD digester, Direct shear apparatus, Triaxial shear apparatus,	LEEW	
35	**Equipment, Instruments and Machineries related to Life Sciences and Biological Sciences including Biotechnology, Nanotechnology, Food Technology, etc.** Electronic Balances, pH Meter, Hot-air-Oven, Microwave Oven, Laminar Air Flow, Autoclave, Microscopes, , Rotatory Evaporators, Centrifuges, Electrophoretic apparatus, Chromatography devices, Grinders, Mixers, Deep Freezers, BOD Incubator, COD Digester, Extraction apparatus, Incubators, CO2 incubator, Heating Mantle, Vacuum pump, Vortex mixer, Magnetic stirrer, Gel rocker, Sonicator, Growth Chambers, Air curtains, Aerators, Spectrophotometers, Calorimeters, Turbidity meter, Colony Counter Water bath, Dry bath, Thermocycler,	LEEW	

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	Gene gun, Gel Documentation System, Transilluminator, Ice maker, ELISA Reader & Washer, Aquarium, Zebrafish / animal house facility, Mechanical & Orbital Shakers, Cyclo mixer, Lyophilizer, Incinerators, Ammeter, Flame Photometer, Fluorimeter, Fermentors, Reactors, Particle size Analyzer, XRD, FTIR, Muffle Furnace		
36	**Chemical Sciences and Engineering Equipment / Machines** Distillation Units, Packed bed distillation, Roll crusher, Jaw crusher, Sieve analysis machine, Shell and tube heat exchangers, Plate and frame filter press, Fume hood, Nephelometer, Membrane Filtration Apparatus, Jar test apparatus	LEEW	
37	**Electrical, Electronics and Communication Engineering Equipment / Machines** DC Shut motor, DC Series motor, DC Compound motor, DC Shunt motor, DC Compound generator, DC series generator, Single phase & Three phase transformers, Single phase & Three phase auto transformers, Loading rheostat, single phase & Three phase, Inductive & Capacitive load, Power electronics trainer kits, Three phase squirrel cage induction motor, Single phase & Three phase induction motor, Three phase slip ring induction motor, AC generator, Stabilizers, Synchronizer, Half and Fully controlled converters, Buck, Boost and buck-boost converters, Single phase and Three phase inverters, Synchros, CRO, DSO, CRO, Microprocessor trainer kits, Microcontroller trainer kits, Arudino trainer kits, Digital electronics trainer kits, Flip-flops, Counters, Half adder, Full adder circuits,	LEEW	
38	**Mechanical Engineering Equipment / Machines** Lathe machine, Milling machine, Drilling machine, Slotting machine, Shaping machine, Cylindrical,	LEEW	

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	Grinding, Coordinate Measuring, Universal testing devices, Thermal Conductor, Air Compressor, Single Cylinder 4 Stroke Diesel Engine, CNC Turning Centre, Kaplan, turbine, Pelton wheel turbine, Francis turbine, Venturimeter, Orifice meter, Nephelometer, CAD & CAM machines, Tensile strength apparatus, Younggus modules apparatus, XRD machines,		
39	**Textile Technology Equipment / Machines** Ring spinning, Rotor spinning, Weaving machine, Ruti C loom, Circular Knitting machine, Curing chamber, Wash Fastness Tester, Streamer, Washing machine, Dryer,	LEEW	

***ITEW- Information technology E waste**

****CEEW- Consumer Electronic E waste**

*****CEHW- Consumer Electronic Hazardous waste**

*******LEEW- Laboratory Equipment E waste**

*Applicable for Hospitals/Labs/Pharmaceutical Industrial sectors

** ** A minimum of 50% criteria should be attained

- *Take feedback from doctors for quality on services for continual improvements.*
- *Provide necessary training to the hospital staff handling waste at the health care Units.*
- *Supply bar-coded biodegradable bags to track the necessary information and keep it in records.*

Source: NSF

1.9. Waste Management Audit Procedure

1.9.1. Waste Management Audit Procedure

A waste audit is performed to calculate the type and amount of waste generated by an organization. It also measures how much waste is recycled vs. thrown out. Thereafter, recycling, reduction, and diversion goals are set, and a management plan is formulated and implemented. Any size organization can perform a waste audit. A waste audit involves three stages:

1.9.2. Pre-audit

At the pre-audit stage, a meeting is conducted to strengthen the audit's scope and objectives and to discuss the possibilities associated with the audit. An audit team is formed at this stage. In the pre-audit meeting, all the participants get the opportunity to meet together, collect available information, and discuss the concerns that help them study before arriving on the site. The audit protocol and audit plan are also handed over to all the members.

1.9.3. Audit

At this stage, the audit team starts working [illegible] the outline scope of the audit as set in the pre-audit stage. All the waste generation and recycling data statistics are

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collected to establish the audit baseline. The best ways of presenting data are evaluated. It includes the following activities:

1. review of documents and records such as admission registers, water charge remittance, furniture registers, laboratory equipment registers, purchase registers, audited statements, and office registers.
2. Interviews or discussion with the staff associated with waste handling, waste management, and other stakeholders
3. Site inspection and data collection

1.9.4. Post-audit

At this stage, the audit team will list the solid waste management problems identified as a result of the audit. A solid waste management plan will be prepared. Strategies are to be selected to address these problems. Auditors determine an action plan and record it on the action plan sheet and provide it to the management of the organisation.

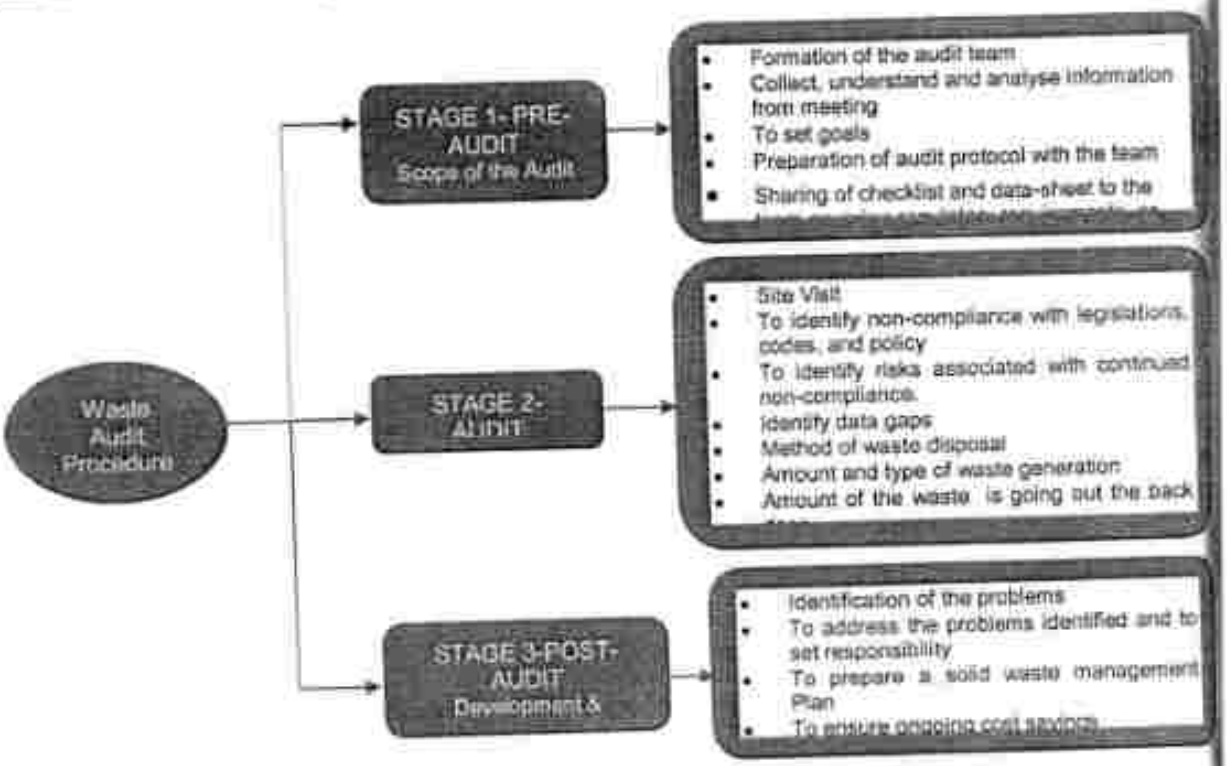

Fig 2. Waste Management Audit Procedure

1.9.5. Steps to Conduct Waste Audit

Before the start of an audit, a lot of prior and ongoing preparations are required. Steps involved in a waste audit are as follows:

Step 1: Plan audit objective

The first step of the waste audit is to understand why there is a need for a waste audit. Is it only to know how much waste is being generated or how much recycling is being done, or is our current management plan in order or to devise better waste management strategies to bring profit out of your waste material? For a better economic and environmental outcome, all participants and coordinators in the waste audit programme should have a specific goal and comprehensive knowledge of it.

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Step 2: Gathering the team and setting a date

To get the best results from the audit, involve representatives from each department of the organisation because every department is responsible for its contribution to the waste generation. Or include a third-party audit team. Next, fix a date for the audit when there is no special event or holiday so that most of the staff will be in the organisation.

Step 3: Determine the waste categories

Before the start of the audit, make a list of the most common waste types generated by the organisation. The most common waste audit categories are given as under:

- Paper & Cardboard
- Glass
- Metals
- Plastic bottles
- Other plastic
- Textiles
- Organic material (Food waste, Garden waste, Agricultural waste, Slaughterhouse waste etc.)
- Aluminium cans
- Materials packaging
- Signage
- Display materials
- Construction & demolition waste
- Hazardous wastes (Paint, Hazardous materials, Biomedical, Batteries, Oil filters and Remainder/composite waste)
- Electrical and electronic equipment
- Tyres
- Furniture
- Ceramics

Step 4: Gather the required Equipment

After choosing the dates and potential participants of the audit, the following equipment and tools are to be stocked so that the team can work properly and safely.

- An open area for sorting the trash.
- A bathroom scale for weighing each category.
- A sieve to separate the small pieces with a gauge of around 1 cm.
- Labelled boxes for sorting each waste category.
- 5 shovels, 5 rakes, and 2 hand brooms.
- Litter pickers (plastic or metal grabbers) to pick and sort the waste if needed.
- Tongs for each volunteer (optional).
- Clipboards for recording your findings.
- 2 wheelbarrows to collect waste from tractors and trailers.
- Trash bags for re-bagging your waste after the audit.
- 1 large first-aid kit including an eye bath.
- Large containers for disposing of waste

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Step 5: Arrange facilities for the staff

While sorting the waste, it is very important to involve the trained staff wearing protective aprons, and protective gear. The following facilities for staff should be made available at the site:

- Drinking water for staff
- Personal protective equipment (PPEs) such as latex or non-latex rubber gloves, rubber boots, goggles, disposable face masks, aprons, water facilities with soap and disinfectant for each volunteer.

Step 6: Sorting the waste into category

Waste generated in the institute or industry is sorted out daily based on the type of waste. The main categories for sorting waste are:

- Organic or compostable waste: food waste, garden waste, dry leaves, grass clippings
- Recyclable waste/Solid rubbish: Plastics, glass, cardboard, textiles, electronics, metal ceramics etc.
- Hazardous waste: chemically reactive substances, flammable substance, corrosive substances
- E-waste
- Batteries
- Biomedical waste
- Liquid waste- organic liquids, waste detergents, polluted water

On the final day of the audit, all the waste and recycling materials must be collected from the whole building. All the waste is to be weighed to get a baseline for how much is thrown away weekly (or as per the audit duration). All the recyclables are also weighed to establish how much waste is being recycled weekly (or as per the audit duration). Waste is to be sorted into different containers as per their categories and must be labelled properly. If the waste is to be analysed department wise, then department wise waste must be collected in different containers and labelled accordingly. The waste source needs to be mentioned in the data sheet. It will give an idea of the accurate estimation and the most waste-generating department in the organisation. An average percentage is to be calculated for every waste. It is necessary to sort and weigh every item found in the audit process.

Waste Audit Data Sheet

Date of Audit _____

S. No.	Items	Weight (kg)	Percentage	Source of Origin	Mode of Disposal
1.	• Food waste				
2.	• Garden waste including dry leaves, grass clippings				
3.	• Other organic waste				

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4.	• Total Organic waste				
5.	Plastics waste				
6.	Glass waste				
7.	Paper & cardboard				
8.	Textiles waste				
9.	Electronics				
10.	Metallic waste				
11.	Ceramics waste				
12.	Biomedical waste				
13.	C&D waste				
14.	Hazardous waste				
15.	Lead Acid Batteries				
16.	Lithium Ion Batteries				
17.	Other				
	Total				

Total weight of waste being thrown away each day: _____ kg.
Total weight of items that can be diverted each day: _____ kg.
Total Weight of Compostable Items each day: _____ (kg)
Total Weight of Recyclable Items each day: _____ (kg)
Waste going to landfill after first audit: _____ kg.
Waste going to landfill after basic diversion: _____ kg.
Waste going to landfill after additional waste-reduction action: _____ kg.

Steps 7: Examine audit results and findings

After taking all weights, this data can be used for a waste stream analysis.

1) Calculate and record the waste diversion rate using this process:

- Divide the weight of recyclables by the combined weight of all the waste (trash + recyclables).
- Multiply the result by 100.

If a composting unit is installed on the premises and waste is being composted.

- Divide the weight of compostable waste by the combined weight of all the waste (trash + compostable).
- Multiply the result by 100.
- This gives you the percentage of waste you divert from the landfill each week.

2) Observe the weights recorded for individual waste categories.

- Which categories are the highest?
- Did the highest categories differ between departments?
- Did you find any recyclables mixed in with the trash?
- Were there categories you didn't realize you had?

Based on the audit results, total waste generated per year, waste generated per person per day, or waste generated per person per year can be calculated.

Waste projections

Total population	
Number of garbage dumps	

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Number of toilets	
Total waste generated (kg/day)	
Total waste generated (Tonne/day)	
Total waste generated (Tonnes/year) approx. 40 weeks	
Waste generated per person (kg/person/year)	
Waste generated per person (kg/person/day)	
Waste generated per person (gm/person/day)	

1.9.6. Cost Estimation

1. Current waste disposal costs Rs._____/month Rs._____/year _____/kg
2. Current recycling costs Rs._____/month Rs._____/year _____/kg
3. Estimated weight that can be diverted from garbage going to landfill ___ year (includes items that can be recycled and composted)
4. Amount saved through reduced disposal costs Rs._____/year
5. Revenue generated by selling soil made by composting Rs._____/year
6. Financial benefit of waste reduction programs (4 + 5) Rs._____/year

Step 8: Audit report preparation

Once the waste audit is completed, based on the audit findings and comparative data of each category and the sources, an audit report is prepared. This report will help to determine the biodegradable, compostable, and recyclable resources out of the trash that has been misused all this time. Based on this data, an action plan is prepared by identifying the waste diversion opportunities and quantifying waste streams. The current waste management system can be improved with the help of a waste audit better than ever.

1.9.7.Steps after Waste Auditing

After completion of the waste audit and waste stream analysis, the auditor should consider the following points:

- It should be double-checked that the dumpster size and frequency of pickup are still adequate for meeting needs.If waste output changes are observed, a different size or number of pickups may be more cost-effective.
- If a recycler should be involved, if no recycling services have been engaged until now, More focus should be on recycling more goods.
- Set waste recycling as a personal goal to increase the recycling rate.
- Recycling instructions or guidelines should be made and distributed among the employees to achieve this goal.
- Set a goal to decrease waste in the most important categories.
- Identify the steps necessary to achieve that goal and communicate them to the team (for example, to save paper, e.g., switch to online bill payment).
- Identify the objects that can be reused, e.g., repairing devices rather than purchasing new ones and reuse of packaging materials.
- It is also necessary to make a schedule for achieving your recycling and waste reduction objectives. A timeline for the achievement of the desired waste reduction can be set for one or two years.
- The next waste audit should be planned at that time to verify if the objectives were reached.

1.10. Action Plan for Waste Reduction

Preparing one's own waste reduction action plan allows one to rethink procedures to produce less waste or redesign processes and hence boost efficiency.

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Step 1: Review the site waste audit report and ensure 3R's actions are being followed.

Review site Waste Audit Report and gather information about the 3R's actions that are currently in place, such as waste reduction strategies, quantity of current waste reduction, reuse, recycling, and disposal, and analysis of operating costs after following 3R's.

Step 2: Using the 3Rs, identify major waste reduction opportunities.

Examining the materials that make up a substantial part of the waste produced is a key aspect in identifying 3R's potential for waste reduction. Consider the cost of waste disposal, the potential for source separation, the potential to reduce, reuse, or recycle, the complexity of handling, and current and potential regulatory requirements.

Step 3: Determine Waste Reduction Priorities After identifying areas for potential waste reduction

Possible impacts of other priorities on the 3R's should be investigated, and at least the following items should be considered when developing a waste reduction action plan: Review the costs and benefits of each waste reduction opportunity. Be aware of anticipated landfill closures, increased tipping fees, or other factors that may affect the disposal of waste and ensure the availability of on-site storage space and storage space with adequate fire safety.

Step 4: Figure Out Why Waste Is Produced?

When evaluating waste reduction possibilities, you should start by asking yourself, "Why is this material being used?" These kinds of questions may be inspiring. Some proposed questions are:

Answers to these questions may reveal possibilities for reducing, reusing, or recycling your waste, such as:

1. Where waste can be eliminated in your operations by reducing the use of specific materials or procedures.
2. Where other materials that can be reused or recycled can be used.
3. Where it is possible to utilise disposable materials.
4. Where you can buy less material. For example, consider bulk purchasing instead of individually packed items.
5. Materials that have been previously recycled can be utilised.
6. Where can you put controls in place to limit waste production during your operations?

Step 5: Identify Waste Reduction, Reuse, and Recycling Opportunities

This section discusses some of the most prevalent 3Rs opportunities. Although the concepts are often simple and can lead to more significant initiatives.

The following are some opportunities to improve the management of waste products:

Reduce Waste

Employees at your facility may already be employing a variety of waste-reduction techniques. Some disposable products may have already been replaced with reusable products in your facility. Use fewer disposable supplies and equipment that you use. Focus on strengthening purchasing rules in administrative departments to reduce the amount of incoming packaging.

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Minimize Paper Usage

Avoiding the waste of paper by implementing double-sided printing and photocopies. E-mail memos and reports to staff or clients instead of providing hard copies. Encourage staff to save digital copies of documents instead of printing them. Remove names from mailing lists if magazines or catalogues are no longer needed.

Bulk Purchasing

To get volume discounts, look into buying in bulk. Bulk purchases frequently come with less packaging than items purchased individually.

Disposable/ Reusable/Eco-friendly Packaging

Request loose products rather than individually packed ones when purchasing supplies.

Instead of using disposable tape dispensers, use permanent tape dispensers.

Request that the package be "taken back" by the vendor or it should be reusable or eco-friendly.

Cafeteria Waste

Single-serve condiment containers should be avoided. Customers that bring their own coffee/travel mug should receive a discount. To cut down on waste, go over the menus again, focusing on portion sizes. Start a "litter less lunch" campaign to encourage employee or students to bring lunches in reusable containers. Napkin dispensers might help you avoid using too many napkins.

Washrooms

Replace disposable hand towel dispensers with hand dryers where possible.

Manufacturing Technology

Where possible, adopt newer production technologies that reduce material usage. Due to older technology, make sure that process start-up and/or cut-off tolerances aren't exorbitant. To avoid waste, improve process controls.

Reuse Equipment

Reusable things can be donated or sold. Charitable organisations are typically interested in equipment and supplies that are no longer needed.

Donate Left Over or Unused Food

Donations of consumable fresh foods and out-of-date packaged foods are welcomed by many food banks. To determine if you can assist in this way, contact your local social organisations.

Recycle Waste

Many recyclable materials, such as corrugated cardboard, office paper, newspaper, glass, aluminium, steel, plastic products, and food waste, have markets. As the markets grow, more items may be added to your recycling list.

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Use of Recyclable Materials

Look for ways to include recycled materials in your products. The success of recycling is dependent on stable material markets. You can contribute to the environment by buying products containing recycled materials.

Internal Recycling

Recycle your own products' materials. Where feasible, introduce processes to support internal recycling of waste materials.

Employee Training on Source Separation

Make sure you segregate the different types of waste materials at source. All personnel should be trained in source-separation techniques and given enough well-labelled containers and storage facilities to collect recyclable material.

Organic Waste

Examine your options for composting. Look into composting organic materials like food waste, leaves and yard trash, and paper towels with private operators or your local government.

Internet or Business Directory

Find recycling companies in your area by using a local business directory or by doing a search on the internet.

Box 1: Follow 3Rs: Reduce , Reuse and Recycle

Reduce

Buy less and use less.

- Purchase recycled papers.
- Use softcopy instead of hard copy
- Purchase environmentally friendly office supplies.
- Choose to purchase items with less packaging.
- Double-side printing and photocopying.
- Use one-sided printed paper instead of throwing in trash.
- Set printer to print double sided as a default setting.
- Print notices on half-sheets.
- Use emails instead of faxes.
- Post newsletters online.
- Avoid printing out emails.

Host paper-free meetings by setting the agenda on the board.

- Use fewer paper towels in the washroom or replace them with electric hand dryer.
- Use refillable soap dispenser in washroom
- Encourage waste-free lunches.
- Reduce the use of tetra-packs by using refillable containers.
- In the dining area replace the paper napkins with the cloth napkins.
- Purchase condiments, sweeteners, salt, and pepper in bulk.
- Use dispensers instead of individually packaged servings.

Reuse

- Replace disposable items with reusable items and learn to share or donate to avoid the landfill.
- Reuse the other side of used paper.
- Use reusable coffee cups and water bottles.
- Stock cafeteria with reusable or biodegradable plates, cups and cutlery.
- Donate uneaten lunch items to a "share a lunch" program.

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- Donate used computers, eyeglasses, cell phones, clothes, textbooks, and other items.
- Host a clothing swap/sale/collection.
- Host a schoolyard/garage sale-type fundraiser

Recycle

- Divert garbage by recycling items such as paper, glass, plastics, cans, tetra packs,

and cardboard.

- Recycle special items such as batteries, electronics, cell phones, and computers.
- Compost organic waste.
- Limit contamination of recycled items by ensuring they are clean.
- Recycle ink and toner products.
- Ensure correct disposal methods are used for chemicals.

Step 6: Evaluate Impact of Material Purchasing Practices on Waste Reduction

Material purchasing procedures involve a lot of waste reduction possibilities. Actions to change the materials used to manufacture your products or provide your services may involve discussions with suppliers. Replacing non-recyclable materials with reusable or recyclable materials gives economic benefits and greater waste diversion.

Step 7: Achievable Waste Reduction Action Plan

A waste reduction action plan is a compilation of the identified waste reduction opportunities and the actions intended to be taken in reducing waste. At this stage, realistic waste reduction targets should be set. It is also important that the work plan is achievable. Excessive over-targeting could have negative effects on employee attitudes and confidence in future work plans. The work plan focuses on the wastes for which reduction measures, actions and objectives have been specified. The format enables us to identify activities on specific waste materials as well as the total amount of waste reduced, reused, and recycled.

1.11. Conclusion

Waste management audit is carried out to provide an indication on how the environmental organization system is working towards the noble cause of environmental protection and nature conservation. To conclude the waste management audit report, the College is an eco-friendly campus and providing very good amicable atmosphere to the stakeholders.

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No. 2669, LIG-II, Gandhi Managar, Peelamedu, Coimbatore - 641 004, Tamil Nadu, India. Website: www.nsfonline.org.in.
Phone: 0422 2510006; Mobile: 9566777255, 9566777258
Email: director@nsfonline.org.in, directornsf@gmail.com.

APPLICATION FOR WASTE MANAGEMENT AUDIT TO ACADEMIC INSTITUTIONS, HOSPITALS AND INDUSTRIAL SECTORS

Reference Number	NSF/WMA 2022-23/Orgn.Name/ Dated:
Name of the Organization & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:
Purpose	To collect and receive the waste materials like e-wastes, wood wastes, construction wastes, plastic wastes, hazardous wastes and biomedical wastes from Academic Institutions, Hospitals / Pharmaceutical and other Industrial Sectors. To ensure proper storage of the wastes as per their classification, characterization, and mode of treatment and disposal. To analyze and decide the treatment and disposal scheme of wastes as per the guidelines of MOEF, CPCB & DPCC. To optimize the treatment and disposal cost by management practices and provide very economical services to the hospitals. To educate and make the individual health care facilities aware of sorting the wastes in a scientific manner and comply with the applicable regulations. To conduct the public awareness programmes to various stakeholders. To search for cost effective and environmental friendly technology for treatment of bio-medical and hazardous waste. To search

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	for suitable materials to be used as containers for biomedical waste requiring incineration/autoclaving/ microwaving. In terms of biomedical wastes, ascertain generation of both infectious and general waste per bed per day for Sub Centres (SC), Additional Primary Health Centres (APHC) and Primary Health Centres (PHCs), Community Health Centres (CHC) and Combined Hospital (CH).

PROCEDURE

Procedure	Description	Responsibility
Annual plan	Each year a plan for the waste management audit is prepared by management. Waste collection and segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of wastes in any establishment. The committee should be responsible for making specific action plan for the waste management and its supervision, monitoring and implementation.	Management Representative
Walk-through Audit	Based on the checklists, the waste management audit is carried out in the form of observations in the Academic Institutions, Hospitals / Pharmaceutical and other Industrial Sectors.	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration.	Campus Coordinator
Reporting and Recommendations	Submission of corrective action in the form of Report in association with the hygiene club / Student Chapters of the Institute.	Lead Auditor EMS Auditor Hygiene Auditor

I. Qualitative and quantitative measurements

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	Remarks
1.	Adequate number of Dust Bins as per Guidelines (Red, Yellow, Blue, and Black & Green Bins) are made available in the campus for various wastes' collection, segregation and disposal.			
2.	Record Register for waste disposal and Puncture proof Containers for Sharps / Blue Bags are made available in the campus			
3.	Mutilators (Needle / syringe cutters) and calibrated weighing machines for biomedical wastes collection*			
4.	Personal protected materials like Gloves, Caps, Masks, Aprons & Gum boots etc. used are adequately made available as per the Guidelines in the campus.			
5.	Around 1% fresh Sodium hypochlorite or Bleaching Powder solution is made available as per guidelines*			
6.	Mercury Spill Management, kit, Post Exposure Prophylaxis Kit and Blood spill Management kit are available*			
7.	Proof of Licensed Companies signed MoU with the Organization for wastes collection as per the Govt. regulation			

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8.	Norms are being followed by the Organization as per the Central and State Government Pollution Control Board			
9.	Different Forms, Formats, Annual Report, etc. are available for waste collection and mode of transportation			
10.	Availability of a trained dedicated with skilled personals for waste management.			
11.	Is the waste segregated at the site of generation? If not, where are they segregated?			
12.	Is the infectious waste and non infectious waste mixed at the source of generation?*			
13.	Is e-wastes, wood wastes, construction wastes, plastic wastes, hazardous wastes and biomedical wastes mixed at the source of generation?			
14.	Is the waste covered in covered bins? and Is the bins filled up to more than ¾ th level ?			
15.	Is the bins cleaned with soap and disinfectant regularly and bins are overfilled? And is the stored waste kept beyond 48-72 hrs?*			
16.	Is the waste transported in closed containers or open bags? and Are the waste collection bins/Trolleys/wheel barrow used for transporting wastes?			
17.	Is the personal protective gears like mask and gloves used while collecting the wastes from the site of deposition?			
18.	Whether the concept of E-Waste management is followed in the campus?			
19.	Has a Management Representative, E-Waste Specialist, Laboratory Staff been assigned?			
20.	Whether E-Waste management practices included in the purchase policy of electronic items?			
21.	Whether an authorised refurbrisher appointed to manage the E-Waste?			
22.	Are the E-Waste refurbished and used again in the institution?			
23.	Whether the importance of waste management and their implications on environmental and personal hygiene through awareness programmes are conducted for stakeholders?			
24.	Signing MOU with Government and NGOs ensure proper handling of waste materials			
25.	Whether construction and wood wastes are subjected to reuse them in the same organization campus?			
26.	Whether plastic wastes are burnt inside the campus? Any air pollution due to plastic materials burning takes place ?			
27.	Projects and dissertation works, scholarly publication on various wastes and their management carried out by staff members and students			
28.	Whether hazardous wastes are properly discarded in which acids, solvents and salts are disposed after diluting with water and poured after buried in the soil			
29.	Have programmes for the achievement of plastic free area objectives and targets been established and implemented as on today? Any display board is made in the campus?			

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30.	Are recycling of plastic polymers promoted in the campus among the stakeholders?			
31.	Wood waste are collected and recycled properly and they used for fuel and degradation / green manuring purposes?			
32.	Residual wastes are properly disposed in the campus after burring the soil with proper dilution with water			

* Applicable for Hospitals/Labs/Pharmaceutical Industrial sectors
** A minimum of 50% criteria should be attained

- *Take feedback from doctors for quality on services for continual improvements.*
- *Provide necessary training to the hospital staff handling waste at the health care Units.*
- *Supply bar-coded biodegradable bags to track the necessary information and keep it in records.*

II. Qualitative measurements

S.No	Name of the Electrical items / Equipment / Instruments	E waste code by NSF	Quantity
1.	Mainframe	ITEW	
2.	Internet connectivity Accessories	ITEW	
3.	Personal computer	ITEW	
4.	Laptop	ITEW	
5.	Dot matrix Printer	ITEW	
	Laser Printer	ITEW	
	Ink jet printer	ITEW	
6.	Cartridge	ITEW	
7.	Xerox machine	ITEW	
	Scanner	ITEW	
	Fax machine	ITEW	
8.	Telephones	ITEW	
9.	Cellar phones	ITEW	
10.	Television	CEEW	
11.	Solar panel	CEEW	
12.	Water heater	CEEW	
	Solar water heater	CEEW	
13.	Split AC	CEEW	
	Window AC	CEEW	
	Centralized AC	CEEW	
	Air Cooler	CEEW	
14.	Tube light	CEEW	
	Fluorescent lamps	CEEW	
	Halogen lamp	CEEW	
	Sodium Vapour lamp	CEEW	
	CFL	CEEW	
	LED tube lights	CEEW	
	LED Focusing lights	CEEW	
15.	Ceiling Fan	CEEW	

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	Pedestal Fan	CEEW	
	Table Fan	CEEW	
	Portable Fan	CEEW	
16.	Lead acid batteries	CEHW	
17.	Lithium Ion Battery	CEHW	
18.	Cable and wires	CEEW	
19.	Inverter with UPS	CEEW	
20.	Switch board	CEEW	
21.	Solar panel	CEEW	
22.	LCD projector	CEEW	
23.	Refrigerator	CEEW	
24.	Water doctor	CEEW	
25.	RO water plant	CEEW	
26.	Generator	CEEW	
27.	Pump	CEEW	
28.	Motors	CEEW	
29.	Compressor	CEEW	
30.	Vacuum Cleaner	CEEW	
31.	Ventilator	CEEW	
32.	Insect trap	CEEW	
33.	Podium containing Mike, Speakers, Amplifiers, Radio, Camera, Sensors, etc.	CEEW	
34.	**Civil Engineering Equipment / Machines** Compressing testing machine, Universal testing machine, Total Station, Theodolites, Flexure testing machine, Torsion testing & Izod impact testing machines, Hardness testing machine, Beam deflection test apparatus, Centrifugal Pump, Gear Pump, Submersible pump, Reciprocating Pump, Pelton Wheel turbine, Francis turbines / Kaplon turbine, Turbidity meter, pH meter, Conductivity meter, Jar test apparatus, BOD incubator, COD digester, Direct shear apparatus, Triaxial shear apparatus,	LEEW	
35	**Equipment, Instruments and Machineries related to Life Sciences and Biological Sciences including Biotechnology, Nanotechnology, Food Technology, etc.** Electronic Balances, pH Meter, Hot-air-Oven, Microwave Oven, Laminar Air Flow, Autoclave, Microscopes, , Rotatory Evaporators, Centrifuges, Electrophoretic apparatus,	LEEW	

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	Chromatography devices, Grinders, Mixers, Deep Freezers, BOD Incubator, COD Digester, Extraction apparatus, Incubators, CO2 incubator, Heating Mantle, Vacuum pump, Vortex mixer, Magnetic stirrer, Gel rocker, Sonicator, Growth Chambers, Air curtains, Aerators, Spectrophotometers, Calorimeters, Turbidity meter, Colony Counter Water bath, Dry bath, Thermocycler, Gene gun, Gel Documentation System, Transilluminator, Ice maker, ELISA Reader & Washer, Aquarium, Zebrafish / animal house facility, Mechanical & Orbital Shakers, Cyclo mixer, Lyophilizer, Incinerators, Ammeter, Flame Photometer, Fluorimeter, Fermentors, Reactors, Particle size Analyzer, XRD, FTIR, Muffle Furnace		
36	**Chemical Sciences and Engineering Equipment / Machines** Distillation Units, Packed bed distillation, Roll crusher, Jaw crusher, Sieve analysis machine, Shell and tube heat exchangers, Plate and frame filter press, Fume hood, Nephelometer, Membrane Filtration Apparatus, Jar test apparatus	LEEW	
37	**Electrical, Electronics and Communication Engineering Equipment / Machines** DC Shut motor, DC Series motor, DC Compound motor, DC Shunt motor, DC Compound generator, DC series generator, Single phase & Three phase transformers, Single phase & Three phase auto transformers, Loading rheostat, single phase & Three phase, Inductive & Capacitive load, Power electronics trainer kits, Three phase squirrel cage induction motor, Single phase & Three phase induction motor, Three phase slip ring induction motor, AC generator, Stabilizers, Synchronizer, Half and Fully controlled converters, Buck, Boost and buck-boost converters, Single phase and Three phase inverters, Synchros, CRO, DSO, CRO, Microprocessor	LEEW	

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	trainer kits, Microcontroller trainer kits, Arudino trainer kits, Digital electronics trainer kits, Flip-flops, Counters, Half adder, Full adder circuits,		
38	**Mechanical Engineering Equipment / Machines** Lathe machine, Milling machine, Drilling machine, Slotting machine, Shaping machine, Cylindrical, Grinding, Coordinate Measuring, Universal testing devices, Thermal Conductor, Air Compressor, Single Cylinder 4 Stroke Diesel Engine, CNC Turning Centre, Kaplan, turbine, Pelton wheel turbine, Francis turbine, Venturimeter, Orifice meter, Nephelometer, CAD & CAM machines, Tensile strength apparatus, Younggus modules apparatus, XRD machines,	LEEW	
39	**Textile Technology Equipment / Machines** Ring spinning, Rotor spinning, Weaving machine, Ruti C loom, Circular Knitting machine, Curing chamber, Wash Fastness Tester, Streamer, Washing machine, Dryer,	LEEW	

***ITEW- Information technology E waste**
****CEEW- Consumer Electronic E waste**
*****CEHW- Consumer Electronic Hazardous waste**
*******LEEW- Laboratory Equipment E waste**

* Applicable for Hospitals/Labs/Pharmaceutical Industrial sectors
** ** A minimum of 50% criteria should be attained

- *Take feedback from doctors for quality on services for continual improvements.*
- *Provide necessary training to the hospital staff handling waste at the health care Units.*
- *Supply bar-coded biodegradable bags to track the necessary information and keep it in records.*

Note: This Audit process and Certificates are valid for three years only from the date of Audit.

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Signature of Auditing Chairman **Signature of the Lead Auditor**

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No. 2669, LIG-II, Gandhi Managar, Peelamedu, Coimbatore - 641 004, Tamil Nadu, India. Website: www.nsfonline.org.in.

Phone: 0422 2510006; Mobile: 9566777255, 9566777258

Email: director@nsfonline.org.in, directornsf@gmail.com.

APPLICATION FOR BIOMEDICAL WASTES MANAGEMENT AUDIT TO HOSPITALS, EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference Number	NSF/BMWMA 2022/Orgn.Name/ Dated:
Name of the Organization & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:
Purpose	To collect and receive the biomedical waste from health care facilities. To ensure proper storage of the wastes as per their classification, characterization, and mode of treatment and disposal. To analyze and decide the treatment and disposal scheme of wastes as per the guidelines of MOEF, CPCB & DPCC. To optimize the treatment and disposal cost by management practices and provide very economical services to the hospitals. Ascertain generation of both infectious and general waste per bed per day for Sub Centres (SC), Additional Primary Health Centres (APHC) and Primary Health Centres (PHCs) and Community Health Centres (CHC). To educate and make the individual health care facilities aware of sorting the wastes in a scientific manner and comply with the applicable regulations. To conduct the public awareness programs. To search for cost effective and environmental friendly [illegible] treatment of biomedical and hazardous waste. To sea[illegible]als to be

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	used as containers for biomedical waste requiring incineration / autoclaving / microwaving.	
PROCEDURE		
Procedure	**Description**	**Responsibility**
Annual plan	Each year a plan for the biomedical waste management audit is prepared by management. Waste collection and segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of bio-medical waste in any establishment. The committee should be responsible for making Hospital specific action plan for the hospital waste management and its supervision, monitoring and implementation.	Management Representative
Walk-through Audit	Based on the checklists, the biomedical waste management audit is carried out in the form of observations in the hospitals/pharmaceutical industries.	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration.	Campus BMWM Coordinator
Reporting and Recommendations	Submission of corrective action in the form of Report in association with the hygiene club / Student Chapters of the Institute.	BMWM Lead Auditor EMS Auditor

II.Qualitative and quantitative measurements

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	Remarks
1.	Adequate number of dust bins for Biomedical wastes disposals as per the BMW Guidelines (Red, Yellow, Blue and Black) and Green bins for General wastes.			
2.	Adequate number of bags for Biomedical wastes as per the Guidelines (Red, Yellow, Blue, and Black) and Green bags for BMW General wastes.			
3.	Puncture Proof Containers for Sharps / Blue Bags kept across in the campus			
4.	Mutilators (Needle / syringe cutters) and Calibrated Weighing machines for Biomedical wastes disposal accuracy including BMW Record Register			
5.	Personal protected equipments like Gloves, Caps, Masks, Aprons & Gum boots etc. used adequately as per the BMW Guidelines.			
6.	Around 1% fresh Sodium hypochlorite or Bleaching Powder Solution as per the BMW Guidelines.			
7.	Mercury Spill Management, kit, Post Exposure Prophylaxis Kit and Blood spill Management kit are made available in the campus as per the BMW Guidelines			
8.	BMW Licenses under Central and State Government Pollution Control Board norms Biomedical waste management			

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9.	Different Forms & Formats (Needle Stick Injury & Annual Report, etc.)			
10.	Availability of a trained dedicated person for BMW Management and implementation.			
11.	Availability trained and skilled BMW person for BMW Collection & Transportation.			
12.	Availability dedicated & trained infection control Nurse available			

III. Generation & Segregation, Collection and Storage, Transportation, Treatment and disposal of biomedical wastes

Generation & Segregation of Biomedical wastes From Wards / O.T.s / ICUs / Labs / OPDs / Blood Bank / Radiology etc. Others				
S.No.	**Details of particulars**	**Yes**	**No**	**Remarks**
1.	Is the biomedical wastes segregated at the site of generation in the campus as per the BMW Guidelines?			
2.	Is the sharp infectious wastes (needles, blades, broken glass etc) to be disposed in white / blue puncture proof Containers?			
3.	Is the non sharp infectious material: (infected plastics, syringe, dressing, gloves, masks, blood bags and urine bags) to be disposed in red plastic bins/bags?			
4..	Is anatomical infectious wastes (Placenta, body parts) to be disposed in yellow plastic b ins or bags?			
5.	Is non infectious (General) waste E.g. packing materials, cartons, fruit and vegetable pills, syringe and needle wrappers, medicine covers to be disposed in Green / Black plastic bins or bags?			
6.	Is the infectious wastes and non infectious wastes mixed at the source of generation?			
Collection and Storage Biomedical Wastes				
1.	Is the biomedical wastes covered in covered bins ?			
2.	Is the bins filled up to more than ¾ th level?			
3.	Is the bins cleaned with soap and disinfectant regularly?			
4.	Is the bins overfilled?			
5.	Is the infectious and non infectious biomedical wastes filled in same / different bins?			
6.	Is the stored biomedical wastes kept beyond 48 hrs duration?			
7.	Is collected biomedical wastes are stored properly as the BMW guidelines?			

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Transportation of biomedical wastes				
1.	Is the biomedical wastes transported in closed containers without any spreading and causing any disease?			
2	Are the biomedical wastes collection bins / Trolleys / wheel barrow used for transporting waste?			
3.	Is the Pre defined route available for transportation of biomedical wastes within the health care facility?			
4.	Is the biomedical wastes transported in open container and bags?			
5.	Is the transportation done during the OPD time or any Emergency?			

Treatment and disposal of biomedical wastes				
1.	Is your biomedical wastes disinfected and mutilated before final disposal			
2.	Is the anatomical sample wastes to be deep buried /incinerated?			
3.	Are the syringes to be cut and chemically disinfected with 1% sodium hypo chloride solution at the source of generation before final disposal?			
4.	Is the infected plastics to be chemically disinfected or autoclaved, shredded and send for final disposal?			
5.	Is the General wastes to be chemically disinfected before final disposal?			
6.	Is the infectious wastes disposed before chemical disinfection and mutilation?			
7.	Can the infectious wastes and non infectious wastes be mixed at any point of time?			

IV. Management of different waste streams measures undertaken

1.	Is the sharp injury reported and is it reported within 7 hrs. If yes then please mention the count per month?			
2.	Are the protective gears like gloves used while handling and syringe?			
3.	Is the barrel and plunger detached before disinfecting the syringe?			
4.	Is the sharp waste mixed with other wastes?			
5.	Is the practice of recapping or bending of needles being done?			
6.	Is the sharp discarded in poly bags properly			
7.	Is the sharp disposed in open area in the campus?			
8.	Is the vials and ampoules disposed in sharp containers?			
9.	Is the anatomical wastes disinfected before final disposal?			

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10.	Is the anatomical wastes disposed in unsecured open areas or in any water bodies?			
11.	Is the personal protective gears like mask and gloves used while handling sputum cups and slides?			
12.	Is the sputum cup or slides disinfected with 5 % hypochlorite solution for at least one hour?			
13.	Is the sputum cups finally disposed inside the premises?			
14.	Is the slides of the Sputum test disposed in sharp container?			
15.	Is the discarded blood bags punctured before disinfection in 5 % sodium hypochlorite solution for at least one hour?			
16.	Is the blood bag discarded without mutilation and disinfection for final disposal?			
17.	Is the plastic waste like IV set, bottles, syringes, latex gloves, catheters etc. cut by scissors before disinfection in 1% sodium hypochlorite solution?			
18.	Is the disposable gloves and masks reused?			
19.	Is liquid waste spillage (blood, body fluid puss or any discharge) disinfected by adding 1% hypochlorite solution before cleaning?			
20.	Is the blood spill cleaned cloth reused?			
21.	Is the mercury spill cleaned with bare hands?			
22.	Is the mercury disposed in waste bins and drains?			
23.	Is the mercury collected into bottle having some water and tightly covered with the lid?			
24.	Is the mercury droplet collected using 2 card board piece / syringe?			
25.	Is the hand washing done before and after any procedure? Eg. collecting lab sample, examination of the patient, handling blood and body fluid.			
26.	Does the hospital personnel visit the final disposal site even if outsourced or done outside the hospital?			
27.	Is the medicine and chemicals stored in same store?			
28.	Signing MOU with Government and NGOs ensure proper handling of biomedical waste materials			
29.	Residual wastes are properly disposed in the campus after burring the soil with proper dilution with water			
30.	Whether hazardous wastes are properly discarded in which acids, solvents and salts used in the clinical laboratories are disposed after diluting with water and poured after buried in the soil.			
31.	Projects and dissertation works, scholarly publication on biomedical wastes and their management carried out by staff members and students			

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32.	Whether the importance biomedical wastes and their implications on environmental and personal hygiene through awareness programmes are conducted for stakeholders?			

* Applicable for Hospitals / Labs / Pharmaceutical Industrial sectors

** A minimum of 50% criteria should be attained

- *Take feedback from doctors for quality on services for continual improvements.*
- *Provide necessary training to the hospital staff handling waste at the health care Units.*
- *Supply bar-coded biodegradable bags to track the necessary information and keep it in records.*

Note: *This Audit process and Certificates are valid for three years only from the date of Audit.*

Signature of Auditing Chairman **Signature of the Lead Auditor**

Signature of the EMS Auditor
Environment Management System
(ISO 14001:2015, TUV NORD)

Signature of BMWM Auditor
Bio Medical Waste Management
(ISO Safety Standards FSMS 22000)

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Ibrahimpatnam(M), R.R.Dist.

NATURE SCIENCE FOUNDATION

(A Unique Research and Development Centre for Society Improvement)

[ISO QMS (9001:2015), EMS (14001:2015), OHSMS (45001:2018) & EnMS (50001:2018) Certified and Ministry of MSME Registered Organization]

No. 2669, LIG-II, Gandhi Managar, Peelamedu, Coimbatore - 641 004, Tamil Nadu, India. Website: www.nsfonline.org.in.

Phone: 0422 2510006; Mobile: 9566777255, 9566777258

Email: director@nsfonline.org.in, directornsf@gmail.com.

APPLICATION FOR BIOMEDICAL E – WASTE MANAGEMENT AUDIT TO HOSPITALS, EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference number	NSF/EWMA 2022-23/Orgn.Name/ Dated:
Name of the Organization & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit (or) renewal process?	☐ New Audit ☐ Renewal Audit Last Audit Date: __/__/__
Purpose	To ensure that the Electronic (E) wastes collected and handled properly which will eventually reduce the E-wastes generation and pollution. In order to reduce the E-Wastes pollution and affect the environmental health, E-Wastes Management Audit may be carried out as per the Checklists. Proper recycling of E-Wastes helps to extract useful materials and reduces the hazardous wastes mixing into atmosphere. Ecofriendly youth leadership, green practices, social responsibility and Institutional values are to comprehend the relationship with the ecosystem for sustainable environment with respect to the E-Waste management practices followed.

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PROCEDURE

Procedure	Description	Responsibility
Annual plan	Each year a plan for the Electronic (E) Wastes Management audit is prepared by Management / Representative and to	Management Representative

	ensure that the E-Waste Management system is implemented in the campus to reduce the environmental pollution and to conserve natural ecosystems.	
Walk-through Audit	Based on the checklists, the Electronic (E) wastes management audit is carried out in the form of observations in the campus.	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration	Environmental Coordinator
Reporting and Recommendations	Submission of corrective action in the form of report in association with Eco club / Student Chapters / Forums of the Institute	Lead Auditor ISO 14001:2015 EMS Auditor

Requirements of general features

1. Total Area_____, Building constructed area_____, Open area
2. Year of establishment:
3. Total Strength of Students:_____ (No. of Boys_____ and No. of Girls_____)
4. Total Strength of Hostellers: _____ (No. of Boys_____ and No. of Girls_____)
5. Total Strength of Teaching Staff: _____ (No. of Males___and No. of Females___)
6. Total Strength of Non-Teaching Staff:___(No. of Males___and No. of Females___)
7. Total Strength of Employees: ___(No. of Males___and No. of Females___)
8. Year of previous NAAC Accreditation:_____ Grade Obtained: _____
9. Size of E-Wastes storage facility _____
10. Name of the Authorized Refurbrisher _____
11. Name of the Authorized transporter _____
12. Name of the Authorized Recycler / Dismantler_____

Check list for Audits Electronic (E) Waste Management Audit (To ensure at least 50% of the following should be attained)

- Total number of Information Technology E-Wastes need report
- Total number of Consumer Electronics E-Wastes need report
- total number of Consumer Electronics hazardous wastes need report
- Total number of Laboratory Equipment E-Wastes need report
- Establishment of E-Wastes storage facility
- Preparing an internal E-Wastes audit procedure
- Designating a representative to monitor the E-Wastes generation
- Labeling and segregation of E-Wastes based on type and toxicity
- Frequency of E-Wastes collection Record maintenance
- Education, training, workshop, camp etc.. related to E-Wastes for stakeholders
- MOU with E-Wastes transporter, refurbrisher and dismantler
- Extended producer responsibility included in the purchase policy to handle E-Wastes
- Implications of utilizing refurbished E-Wastes in purchase policy
- E-Wastes handlers equipped with suitable safety gears

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- Installation of exclusive E-Wastes bin to collect E-Wastes in campus from stakeholders
- Implementation of Government and Non-Governmental Organization schemes
- E-Waste types like computers, mobile phones, sensors, electrical and electronic items
- Fridges, freezers and other cooling equipment and telecommunications equipment
- Consumer electronic devices and solar panels, solar water heaters
- TVs, LCD projectors, monitors and screens, public addressing system
- Tube lights, Flourescent bulbs, LED, CFL bulbs, ultra-violet lights and etc.
- Vending machines, HVLS fans, exhaust fans, motors, electric wires, switches
- Power generators, uninterruptible power supply (UPS), AC machines, lifts, ventilators,
- Refrigerators, oven, microwave oven, water pumps, etc
- RO Plants, water doctors and distillation units, water pumps

I. Qualitative measurement

S.No	Requirements and checklists of the audit	Conformity		
		YES	NO	NA
1.	Whether the concept of E-Waste management is followed in the campus?			
2.	Have internal E-Wastes audit procedures been developed and implemented in organisation?			
3.	Has a Management Representative, E-Wastes Specialist, Laboratory Staff been assigned?			
4.	Whether E-Waste management practices included in the purchase policy of electronic items?			
5.	Whether an authorised refurbrisher appointed to manage the E-Waste?			
6.	Are the E-Wastes refurbished and used again in the institution?			
7.	Whether any MOU signs with authorised recycler / dismantler to recycle / dismantle the E-Wastes?			
8.	Whether E-Wastes collection bins installed in the campus for collection of E-Wastes?			
9.	Whether E-Wastes are handled based on its toxicity with safety precautions?			
10.	Whether E-Wastes awareness programmes are conducted for stakeholders?			
11.	Are the E-Waste handlers provided with safety gears, wearing masks and caps as per the guidelines?			
12.	Signing MOU with Government and NGOs to ensure proper handling of E-wastes			
13.	Any initiative to reduces E-Wastes in the campus been developed and action taken?			
14.	Projects and dissertation works, scholarly publication on E-Wastes management carried out by staff members and students			

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15.	Whether E-Wastes managed by extended producer responsibility model being carried out?			
16.	Whether the generated E-Wastes are segregated onsite and method of segregation and record maintenance?			
17.	Whether the E-Wastes are transported to refurbrisher and Dismantler by authorised transporters?			
18.	Implementation of Government and Non-Governmental Organizations schemes to create awareness on E-Wastes			
19.	Whether E-Vehicles are used inside the campus to reduce the E-wastes pollution?			
20.	Whether E-Wastes are collected frequently and segregated and evidence on record entry?			
21.	E-Waste drives inside and outside the campus to educate people about the electronic waste disposal.			

II. Quantitative measurements

S.No	**Name of the Electrical items / Equipment / Instruments**	**E waste code by NSF**	**Quantity**
1.	Mainframe	ITEW	
2.	Internet connectivity Accessories	ITEW	
3.	Personal computer	ITEW	
4.	Laptop	ITEW	
5.	Dot matrix Printer	ITEW	
	Laser Printer	ITEW	
	Ink jet printer	ITEW	
6.	Cartridge	ITEW	
7.	Xerox machine	ITEW	
	Scanner	ITEW	
	Fax machine	ITEW	
8.	Telephones	ITEW	
9.	Cellar phones	ITEW	
10.	Television	CEEW	
11.	Solar panel	CEEW	
12.	Water heater	CEEW	
	Solar water heater	CEEW	
13.	Split AC	CEEW	
	Window AC	CEEW	
	Centralized AC	CEEW	
	Air Cooler	CEEW	
14.	Tube light	CEEW	
	Fluorescent lamps	CEEW	
	Halogen lamp	CEEW	
	Sodium Vapour lamp	CEEW	
	CFL	CEEW	
	LED tube lights	CEEW	

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	LED Focusing lights	CEEW	
15.	Ceiling Fan	CEEW	
	Pedestal Fan	CEEW	
	Table Fan	CEEW	
	Portable Fan	CEEW	
16.	Lead acid batteries	CEHW	
17.	Lithium Ion Battery	CEHW	
18.	Cable and wires	CEEW	
19.	Inverter with UPS	CEEW	
20.	Switch board	CEEW	
21.	Solar panel	CEEW	
22.	LCD projector	CEEW	
23.	Refrigerator	CEEW	
24.	Water doctor	CEEW	
25.	RO water plant	CEEW	
26.	Generator	CEEW	
27.	Pump	CEEW	
28.	Motors	CEEW	
29.	Compressor	CEEW	
30.	Vacuum Cleaner	CEEW	
31.	Ventilator	CEEW	
32.	Insect trap	CEEW	
33.	Podium containing Mike, Speakers, Amplifiers, Radio, Camera, Sensors, etc.	CEEW	
34.	**Civil Engineering Equipment / Machines** Compressing testing machine, Universal testing machine, Total Station, Theodolites, Flexure testing machine, Torsion testing & Izod impact testing machines, Hardness testing machine, Beam deflection test apparatus, Centrifugal Pump, Gear Pump, Submersible pump, Reciprocating Pump, Pelton Wheel turbine, Francis turbines / Kaplon turbine, Turbidity meter, pH meter, Conductivity meter, Jar test apparatus, BOD incubator, COD digester, Direct shear apparatus, Triaxial shear apparatus,	LEEW	
35.	**Equipment, Instruments and Machineries related to Life Sciences and Biological Sciences including Biotechnology, Nanotechnology, Food Technology, etc.** Electronic Balances, pH Meter, Hot-air-Oven, Microwave Oven, Laminar Air Flow, Autoclave, Microscopes, , Rotatory Evaporators, Centrifuges, Electrophoretic apparatus,	LEEW	

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	Chromatography devices, Grinders, Mixers, Deep Freezers, BOD Incubator, COD Digester, Extraction apparatus, Incubators, CO2 incubator, Heating Mantle, Vacuum pump, Vortex mixer, Magnetic stirrer, Gel rocker, Sonicator, Growth Chambers, Air curtains, Aerators, Spectrophotometers, Calorimeters, Turbidity meter, Colony Counter Water bath, Dry bath, Thermocycler, Gene gun, Gel Documentation System, Transilluminator, Ice maker, ELISA Reader & Washer, Aquarium, Zebrafish / animal house facility, Mechanical & Orbital Shakers, Cyclo mixer, Lyophilizer, Incinerators, Ammeter, Flame Photometer, Fluorimeter, Fermentors, Reactors, Particle size Analyzer, XRD, FTIR, Muffle Furnace		
36.	**Chemical Sciences and Engineering Equipment / Machines** Distillation Units, Packed bed distillation, Roll crusher, Jaw crusher, Sieve analysis machine, Shell and tube heat exchangers, Plate and frame filter press, Fume hood, Nephelometer, Membrane Filtration Apparatus, Jar test apparatus	LEEW	
37.	**Electrical, Electronics and Communication Engineering Equipment / Machines** DC Shut motor, DC Series motor, DC Compound motor, DC Shunt motor, DC Compound generator, DC series generator, Single phase & Three phase transformers, Single phase & Three phase auto transformers, Loading rheostat, single phase & Three phase, Inductive & Capacitive load, Power electronics trainer kits, Three phase squirrel cage induction motor, Single phase & Three phase induction motor, Three phase slip ring induction motor, AC generator, Stabilizers, Synchronizer, Half and Fully controlled converters, Buck, Boost and buck-boost converters, Single phase and Three phase inverters, Synchros, CRO, DSO, CRO, Microprocessor trainer kits, Microcontroller trainer kits, Arudino	LEEW	

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	trainer kits, Digital electronics trainer kits, Flip-flops, Counters, Half adder, Full adder circuits,		
38.	**Mechanical Engineering Equipment / Machines** Lathe machine, Milling machine, Drilling machine, Slotting machine, Shaping machine, Cylindrical, Grinding, Coordinate Measuring, Universal testing devices, Thermal Conductor, Air Compressor, Single Cylinder 4 Stroke Diesel Engine, CNC Turning Centre, Kaplan, turbine, Pelton wheel turbine, Francis turbine, Venturimeter, Orifice meter, Nephelometer, CAD & CAM machines, Tensile strength apparatus, Younggus modules apparatus, XRD machines,	LEEW	
39.	**Textile Technology Equipment / Machines** Ring spinning, Rotor spinning, Weaving machine, Ruti C loom, Circular Knitting machine, Curing chamber, Wash Fastness Tester, Streamer, Washing machine, Dryer,	LEEW	

***ITEW- Information technology E waste**
****CEEW- Consumer Electronic E waste**
*****CEHW- Consumer Electronic Hazardous waste**
*******LEEW- Laboratory Equipment E waste**

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III. E-Wastes handling Data sheet

Description	Type of Waste	Number	Weight
E-Wastes generated	ITEW		
	CEEW		
	CEHW		
	LEEW		
E-Wastes stored	ITEW		
	CEEW		
	CEHW		
	LEEW		
E-Wastes Transported	ITEW		
	CEEW		
	CEHW		
	LEEW		
E-Wastes Sent to Refurbrisher	ITEW		
	CEEW		
	CEHW		
	LEEW		

E-Wastes Sent to Dismantler	ITEW		
	CEEW		
	CEHW		
	LEEW		
E-Wastes managed by Extended producer responsibility model	ITEW		
	CEEW		
	CEHW		
	LEEW		
E-Wastes Recycled and Transported back to Institution	ITEW		
	CEEW		
	CEHW		
	LEEW		

A minimum of 50% criteria should be attained

Note: *This Audit process and Certificates are valid for three years only from the date of Audit*

Signature of the Chairman

Signature of the Lead Auditor

Signature of the EMS Auditor
Environment Management System

Signature of the Auditor / Experts
Certified by NSF / IGBC / LEED

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No. 2669, LIG-II, Gandhi Managar, Peelamedu, Coimbatore - 641 004, Tamil Nadu, India. Website: www.nsfonline.org.in.

Phone: 0422 2510006; Mobile: 9566777255, 9566777258

Email: director@nsfonline.org.in, directornsf@gmail.com.

APPLICATION FOR PLASTIC WASTE MANAGEMENT AUDIT TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference Number	NSF/PWMA 2022/Orgn.Name/	Dated:
Name of the Organization & Address		
Date of Audit		
Name of the Lead and EMS Auditors		
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:	
Purpose	The initiative aims to establish environment-friendly plastic waste disposal solutions. In the process it seeks to ban the use of plastic bags and plastic products, and reduce plastic littering across the state	

PROCEDURE

Procedure	Description	Responsibility
Annual plan	Each year a plan for the plastic waste management audit is prepared by Management and to ensure that the environmental management system and ecosystem service are implemented in the campus.	Management Representative
Walk-through Audit	Based on the checklists, the plastic waste management audit is carried out in the form of observations in the campus.	Audit team

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Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration.	Plastic waste management Coordinator
Reporting and Recommendations	Submission of corrective action in the form of report in association with Eco club / Student Chapters of the Institute.	Lead Auditor ISO 14001:2015 EMS Auditor

I. Qualitative Measurements

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have internal plastic waste management audit a procedures been developed and implemented in the Organization?			
2.	Have programmes for the achievement of plastic free area objectives and targets been established and implemented as on today?			
3.	Whether plastic waste management audit is being carried out periodically?			
4.	Whether Swachh Bharat Mission as per the Ministry of Housing and Urban affairs, New Delhi concepts followed?			
5.	Have responsibilities been assigned for programmes at each appropriate function and level?			
6.	Are objectives and targets documented towards plastic waste management audit periodically and any Register is made?			
7.	Signing of MoU with Govt. and NGOs to disseminate Plastic free campus motto and pledge			
8.	Are information like name, registered number, and thickness of the carry bags are known?			
9.	Are plastic waste in mixed waste and residual waste streams are monitored?			
10.	Are recycling of plastic polymers promoted among the stakeholders in the campus?			
10.	Details for assessment of handling, storage, transportation and disposal methods			
11.	Do you sell recycled plastics in the campus as the consultancy services?			
12.	Percentage of Organization's budget for environment sustainability efforts			
13.	Sufficient number of dust bins kept separately for plastics, metals, paper, hazardous, biowastes, E-wastes biomedical wastes and construction wastes			
14.	Record Register for waste disposal and Puncture proof Containers for Sharps / Blue Bags are made available			
15.	Proof of Licensed Companies signed MoU with the Organization for wastes collection as per the Govt. regulation			
16.	Norms are being followed by the Organization as per the Central and State Government Pollution Control Board			

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17.	Is the plastic waste segregated at the site of generation? If not, where are they segregated?			
18.	Has a Management Representative, Plastic Waste management Specialist, laboratory staff been assigned?			
19.	Whether E-Waste management practices included in the purchase policy of electronic items?			
20.	Whether the importance Plastic wastes and their implications on environmental and personal hygiene through awareness programmes are conducted for stakeholders?			
21.	Whether plastic wastes are burnt inside the campus? Any air pollution due to plastic materials burning takes place ?			
22.	Have programmes for the achievement of plastic free area objectives and targets been established and implemented as on today?, Any display board is made in the campus?			
23.	Avoidance of plastic bags, disposal cups, plates, stirrers, forks, spoons, candy sticks, wrapping films, PVC banners in the campus			

2. Quantitate Measurements

S.No	Details of Particulars	Remarks	Explanation
1.	Widespread separate collection of dry recyclable materials		
2.	Widespread separate collection of biowastes and plastic wastes		
3.	Landfills/incineration bans for some materials		
4.	Toward circular economy- A zero waste programme		
5.	How many times recycled plastic are used?		
6.	Transformation of plastic into energy fuels?		

Note: *This Audit process and Certificates are valid for three years only from the date of Audit.*

Signature of the Chairman

Signature of the EMS Auditor
Environment Management System

Signature of the Lead Auditor

Signature of the Auditors / Experts
Certified by NSF / IGBC / LEED

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Phone: 0422 2510006; Mobile: 9566777255, 9566777258
Email: director@nsfonline.org.in, directornsf@gmail.com.

APPLICATION FOR SOIL AND WATER AUDIT TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference Number	NSF/SWA 2022/Orgn.Name/ Dated:
Name of the organisations & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit or renewal Purpose?	☐ New Audit ☐ Renewal Audit Last Audit Date: __/__/____
Purpose	To ensure the sustainable land and water use practices followed for the preservation soil fertility and water quality parameters to ensure the green cover area of an organization and to provide safe water to the stakeholders better human health. Ecofriendly youth leadership, green practices, social responsibility and institutional values towards the water and soil conservation are to comprehend the relationship with the ecosystem for sustainable environment.

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PROCEDURE

Procedure	Description	
Annual plan	Each year a plan for the soil and water audit is prepared by the Management and to ensure that the quality of soil and water is preserved by implementing sustainable practices.	Management Representative

Walk-through Audit	Based on the checklists, the soil and water audit is carried out in the form of observations in the campus	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration	Environmental Coordinator
Reporting and Recommendations	Submission of corrective action in the form of report in association with Nature Club / Eco club / Student Chapters of the Institute	Lead Auditor ISO 14001:2015 EMS Auditor

I. Requirements of general features

1. Total Area_____, Building constructed area_____, Open area
2. Year of establishment:
3. Total Strength of Students:_____ (No. of Boys_____ and No. of Girls_____)
4. Total Strength of Hostellers: _____ (No. of Boys_____ and No. of Girls_____)
5. Total Strength of Teaching Staff: _____ (No. of Males____and No. of Females___)
6. Total Strength of Non-Teaching Staff:___(No. of Males___and No. of Females___)
7. Total Strength of Employees: ___(No. of Males___and No. of Females___)
8. The ratio of open space area to total area:
14. Total number of bore wells, open wells, water reservoirs, check dam and etc.
15. Total number of streams, spring and rain harvesting system in the campus
16. Report of Physico-chemical parameters of water quality
17. Report of Drinking / Potable water, RO water, Tap water, Corporation water
18. Total number of taps and faucets, toilets, showers, rest rooms, etc.
19. Total number of laboratory sinks, wash basins at canteens, hostels, kitchens
20. Leak detection, leak repairs, water pumping works towards water conservation
21. Sprinkler system if available for irrigation system for effective water management
22. Water contamination and related issues including water logging during heavy rains
23. Installation of water saving devices like automatic system, water meter, etc.
24. Sewage Treatment Plant availability and its uses including gardening and lawn care practices
25. Water wise landscaping, gardening, efficient irrigation and lawn care practices.
26. Detection of *Escherichia coli*, Coliform bacteria and Faecal Coliform bacteria in water
27. Report of soil profile and soil fertility analysis

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I. Qualitative Measurements

S.No	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have an internal audit procedure for soil analysis been at implemented in the organisation			
2.	Whether soil profile analysis carried out in the campus?			
3.	Whether soil fertility analysis preferred in the campus?			

4.	Whether soil organic matter and above the ground biomass analysed?			
5.	Whether any streams /springs presence observed inside the campus			
6.	Does any decline in water quality and water quantity observed in recent times.			
7.	Whether any decrease in green cover observed in the campus?			
8.	Whether any key alteration in the soil species observed?			
9.	Whether any change in the water use /land used pattern followed in recent times?			
10.	Does soil erosion and associated issues observe inside the campus?			
11.	Does soil acidification and associated issues observe inside the campus?			
12.	Does soil contaminations and associated issues observe inside the campus?			
13.	Number of bore wells, open wells, water reservoirs, Water supply, check dam and etc. are sufficient in the campus			
14.	Whether any water logging problem arise inside the campus ?			
15.	Whether any loss of soil and water biodiversity observed inside in the campus			
16.	Whether any programmes launched recently on soil and water conservation?			
17.	Whether any sustainability goals formulated for sustainable land use & rain harvesting system in the campus?			
18.	Number of taps and faucets, toilets, showers, rest rooms, etc. in sufficient numbers in the campus coinciding with the human population			
19.	Efforts taken towards water leakage, leak detection & repairs, water pumping works towards water conservation			
20.	Sprinkler system if available for irrigation system for effective water management			
21.	Water contamination and related issues including water logging during heavy rains			
22.	Installation of water saving devices like automatic system, water meter, etc.**			
23.	Sewage treatment plant availability and its use including gardening fir efficient irrigation and lawn care practices, water wise landscaping, etc.			
24.	Whether vermicomposting or any similar process carried out inside the campus for soil health preservation?			

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25.	Does any programmes conducted to educate stakeholders the importance of sustainable land use?			
26.	Whether any investment carried out for sustainable land use and its conservation?			
27.	Whether any action plan devised to restore the degraded land?			
28.	Whether campus comes under seismic zone and protective zone under Govt. act? **			
29.	Whether vermicomposting or any similar process carried out inside the campus for soil health preservation?			
30.	Detection of *Escherichia coli*, Coliform bacteria and Faecal Coliform in water			

II. Qualitative measurements

Table 1. Soil Profile and Soil Edaphic parameters of the Organization Campus.

S.No	Description	Results / Observations
I. Physical parameters of soils		
1.	pH	
2.	Electrical Conductivity (µmhos/cm)	
3.	Water holding capacity (%)	
4.	Sand: Gravel: Clay Ratio	
5.	Moisture Content (%)	
6.	Dry matter Content (%)	
II. Macro Nutrients estimations in soils		
7.	Total Organic carbon (%)	
8.	Available Nitrogen (%)	
9.	Exchangeable Potassium (mg/kg)	
10.	Available Phosphorous (mg/kg)	
III. Micro Nutrients estimations in soils		
11.	Calcium (mg/kg)	
12.	Magnesium (mg/kg)	
13.	Sodium (mg/kg)	
14.	Manganese (mg/kg)	
15.	Zinc (mg/kg)	
16.	Ferric (mg/kg)	

Table 2. Physical and chemical parameters of water samples collected at different sources of the Organization Campus.

S.No.	*Parameters*	*Tap water*	*RO water*	*Recycled Wastewater*
1.	*pH*			
2.	*Conductivity (micromhos/cm)*			
3.	*Colour (Hazen unit)*			
4.	*Colour & Odour*			
5.	*Taste*			

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6.	*Total dissolved Solids**			
7.	*Hardness**			
8.	*BOD**			
9.	*COD**			
10.	*Dissolved oxygen**			
11.	*Dissolved CO_2**			
12.	Turbidity (NTU)			
13.	Alkalinity*			
14.	*Salinity**			
15.	Acidity*			
16.	Nitrate*			
17.	Chloride*			
18.	Sulphate*			
19.	Fluoride*			
20.	*Iron**			

* *mg/l*

Table 3. Number of Microbial colonies in Soil and Water samples at different locations of the Organization Campus.

S.No.	Name of the Place	Number of Microbial colonies (cfu) *			
		Bacterial colonies	Fungal colonies	Actinomycete colonies	Total colonies / Average
1.	Water Sample I				
2.	Water Sample II				
3.	Water Sample III				
4.	Soil Sample I				
5.	Soil Sample II				
6.	Soil Sample III				

* Applicable for Industrial sectors ** A minimum of 50% criteria should be attained

Note: *This Audit process and Certificates are valid for three years only from the date of Audit.*

Signature of the Auditing Chairman

Signature of the Lead Auditor

Signature of the EMS Auditor

Signature of the Soil / Water Auditor Environment Management System (NABL Accredited Lab Specialist)

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VIJAYAWADA-520 010.

CHECK LIST FOR AUDITS

Waste Management Audit (To ensure at least 50% Achievements should be reached)

- Different coloured dustbin maintenance for the disposal of degradable and non-degradable wastes; respectively.
- Personal protected materials like Gloves, Caps, Masks, Aprons & Gum boots etc. used are adequately made available as per the Guidelines in the campus for personal safety.
- Different Forms, Formats, Annual Report, etc. are available for waste collection and mode of transportation for disposal.
- Proper disposal of residual wastes inside the campus as per the records.
- Regular cleaning of the dustbins with soap and disinfectant for their reuse.
- Availability of a trained dedicated with skilled personals for waste management.
- Implementation of Government schemes (Swatch Bharath) if any.
- Signing of MoU with Govt. NGOs for waste collection towards disposal.
- Reuse of construction and wood wastes including any biowastes inside the campus.
- Awareness programmes conducted towards the 'Waste management activities' inside the campus to the stakeholders.
- Projects and dissertation works, scholarly publication on various wastes and their management carried out by staff members and students.
- Segregation and disposal of infectious and non-infectious wastes (biomedical wastes) at the source of generation.
- Segregation and disposal of e-wastes, plastic wastes, chemical wastes and hazardous wastes at the source of generation.
- Personal protective gears like mask and gloves used while collecting the wastes from the site of deposition.
- Any display boards, slogans and sign boards placed inside the campus to ensure waste management practices.
- Special initiatives taken to control the pollution, E- Waste, Plastic waste, Wood waste, Construction waste, hazardous waste, Biomedical waste and etc. inside the campus.
- Education, training, workshop, camp, etc., conducted for the waste management among the students and staff members.
- Supply bar-coded biodegradable bags to track the necessary information and keep it in records.

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Biomedical Waste Management Audit (To ensure at least 50% Achievements should be reached)

- • BMW Licenses under Central and State Government Pollution Control Board norms Biomedical waste management
- Personal protected equipment's like Gloves, Caps, Masks, Aprons & Gum boots etc. used adequately as per the BMW Guidelines.
- Adequate number of dust bins for biomedical wastes disposals as per the BMW Guidelines.
- Adequate number of bags for Biomedical wastes as per the Guidelines
- Availability trained and skilled BMW person for BMW Collection & Transportation.
- Disposal of sharp infectious waste in white / blue puncture proof Containers at the source of generation
- Disposal of Non – sharp infectious waste in red plastic bins/bags at the source of generation
- Disposal of Anatomical waste in yellow plastic bins or bags at the source of generation
- Segregation of infectious and non – infectious waste at the source of generation
- Using of covered dustbins inside the campus.
- Regular cleaning of the dustbin with soap and disinfectant
- Storage of bio – medical waste should not exceed more than 48hrs
- Pre-defined route available for transportation of biomedical wastes within the health care facility
- Transportation of Bio – Medical waste in the closed container without causing any disease to the stakeholders
- Transportation facilities during the OPD time or any Emergency situation
- Projects and dissertation works, scholarly publication on biomedical wastes and their management carried out by staff members and students
- Awareness programmes conducted towards the importance of biomedical wastes and their implications on environmental and personal hygiene for stakeholders
- Mercury Spill Management kit, Post Exposure Prophylaxis Kit and Blood spill Management kit are made available in the campus as per the BMW Guidelines
- Proper Treatment and disposal of Bio – Medical waste.
- Measures undertaken for the management of different waste streams.
- Supply bar-coded biodegradable bags to track the necessary information and keep it in records.

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E -Waste Management Audit (To ensure at least 50% Achievements should be reached)

- Total number of Information Technology E-Wastes need report
- Total number of Consumer Electronics E-Wastes need report
- total number of Consumer Electronics hazardous wastes need report
- Total number of Laboratory Equipment E-Wastes need report
- Establishment of E-Wastes storage facility
- Preparing an internal E-Wastes audit procedure
- Designating a representative to monitor the E-Wastes generation
- Labeling and segregation of E-Wastes based on type and toxicity
- Frequency of E-Wastes collection Record maintenance
- Education, training, workshop, camp etc.. related to E-Wastes for stakeholders
- MOU with E-Wastes transporter, refurbrisher and dismantler
- Extended producer responsibility included in the purchase policy to handle E-Wastes
- Implications of utilizing refurbished E-Wastes in purchase policy
- E-Wastes handlers equipped with suitable safety gears
- Installation of exclusive E-Wastes bin to collect E-Wastes in campus from stakeholders
- Implementation of Government and Non-Governmental Organization schemes
- E-Waste types like computers, mobile phones, sensors, electrical and electronic items
- Fridges, freezers and other cooling equipment and telecommunications equipment
- Consumer electronic devices and solar panels, solar water heaters
- TVs, LCD projectors, monitors and screens, public addressing system
- Tube lights, Flourescent bulbs, LED, CFL bulbs, ultra-violet lights and etc.
- Vending machines, HVLS fans, exhaust fans, motors, electric wires, switches
- Power generators, uninterruptible power supply (UPS), AC machines, lifts, ventilators,
- Refrigerators, oven, microwave oven, water pumps, etc
- RO Plants, water doctors and distillation units, water pumps

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Plastic Waste Management Audit (To ensure at least 50% Achievements should be reached)

- Signing of MoU with Govt. NGOs to ensure plastic free campus maintenance
- Functioning of Eco club, Cell, Forum, Association, etc. for Students to maintain plastic free Campus
- Government schemes (Swatch Bharath) if any
- Hazardous material disposal facility
- Management Representative if any in the campus
- Mechanism of monitoring (plastic waste in mixed waste and residual waste)
- Projects and Dissertation works carried out by the staff and students
- Recycling of plastic polymers collected from the Campus
- Education, training, workshop, camp and etc conducted to maintain the plastic free campus
- Alternative Sources used to control the use of the plastics inside the campus
- Record Register for waste disposal and Puncture proof Containers for Sharps / Blue Bags
- Awareness programmes conducted towards the avoidance of plastic usage
- Slogans and sign boards placed inside the campus ensuring not to use plastics
- Preventive measures taken for the avoidance of plastic bags, disposal cups, plates, stirrers, forks, spoons, candy sticks, wrapping films, PVC banners in the campus
- Blue colour dustbin maintenance in and around the campus for plastic waste disposal

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CHECK LIST FOR SOIL AND WATER AUDIT
(Ensure that at least 50% of the Data should be attained)

- Total number of Plants, Animals, Birds in the campus
- Average number of bacteria, fungi and actinomycetes in soils
- Soil profile and soil fertility analysis report
- Soil erosions, soil acidification, contamination and related issues
- Detection of Escherichia coli, Coliform bacteria and Faecal Coliform in water
- Detection of Salmonella, Shigella and Vibrio cholerae in drinking water samples
- Total number of bore wells, open wells, water reservoirs, check dam and etc.
- Total number of streams, spring and rain harvesting system in the campus
- Physico-chemical parameters of water quality
- Report of Drinking / Potable water, RO water, Tap water, Corporation water
- Proper inland drainage provided for water logging problem
- Steps taken for water logging during heavy rains and natural disaster
- Afforestation practices followed in recent times
- Use of biofertilizer, organic manure and vermicompost in soil health maintenance
- Internal audit system and procedure for soil and water analysis
- Education and training programmes related to soil and water audit

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A Manual on

Environmental Management Audits

for Educational Institutions and Industrial Sectors

Editors

Dr. B. Mythili Gnanamangai

Dr. G. Murugananth

Dr. S. Rajalakshmi

NSF

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NATURE SCIENCE FOUNDATION

No. 2669, LIG-II, Gandhi Managar, Peelamedu, Coimbatore - 641 004

Tamil Nadu, India.

Phone: 0422 2510006, Mobile: 95667 77255, 95667 77258

Email: directornsf@gmail.com, director@nsfonline.org.in

PREFACE

Environment Management System is the quantitative and qualitative data to track air, water and waste, and to gain actionable insights to improve the operational performance. It is used to maintain the clean and green environment that leads to the stakeholders. It provides a solution at 360' view of a surrounding campus and makes it easy for Owners / Managers/ Environmentalists to collaborate, measure, control, and reduce environmental impacts. Finally it leads to enhancing the quality of life for human beings, animals and plants. Green Campus Initiatives are the need of the hour across the world due to change in environmental conditions, global warming and increasing human population. It aims to make a sustainable and environmental friendly campus for stakeholders.

Environmental Management Audits such as Environment audit, Green Campus Audit, Energy Audit and Hygiene Audit are a well-developed process of extracting information about an Institution and Organization that provides a realistic assessment of how the Institutions and Organizations take steps towards protecting the environment. In order to save the ecofriendly atmosphere of an Institution and Organization, well-developed environmental objectives and targets should be undertaken to reduce the harmful effects to a greater extent. These audits can minimize the environmental pollution in the campus remarkably which in turn reduce the global warming effect as a whole. As per the Government law, the environmental legislations should be followed by all the Institutions and Organizations and make sure that their activities should not destroy the environment.

Nature Science Foundation (NSF), Coimbatore, Tamil Nadu, India is functioning energetically to conduct different awareness programmes and implement various schemes to Schools, Colleges and Universities across India towards the noble cause of environmental protection and nature conservation. The main motto of the NSF is "Save the Nature to save the Future" and "Go Green to save the Planet". NSF is a Non-Governmental ISO 9001:2015 certified organization under the Nature Science Foundation. Public Charitable Trust managed by a board of trustees. It is a non-profitable Foundation registered under the Societies registration Act 1975 (TN Act 27 of 1975).

The authors have taken enormous efforts to prepare this 'Environment Management Audit Manual' in a big way. Treatment of the subject matter has been very simple, clear and comprehensive. The authors followed lucid language with a maximum number of illustrations and photographs for easy understanding of the subject contents by the Readers. This manual will be definitely useful for the Lead Auditors those who are conducting audits on Environment Management perspectives.

I express my sincere appreciation to all the authors in bringing out such a useful manual and took efforts in getting Copyright and publishing this Manual through a reputed publisher through proper channels.

CHAIRMAN
NATURE SCIENCE FOUNDATION
COIMBATORE, TAMIL NADU, INDIA

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(Vill): SHERIGUDA-501 510,
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ACKNOWLEDGEMENT

Environmental audit is a process to ensure that the environment is not disturbed from its balanced existence, so that it provides an ecofriendly atmosphere to the stakeholders. Similar to that of Environmental audit, Green campus audit is a type of assessment to ensure that the Institution and Organization campus is conserving plant species by planting a large number of trees and lawns in the campus. Energy audit ensures that the campus of Institutions and Organizations is involved in energy savings and planned consumption towards the roadmap of the State development economy by assessing the electric current usage.

We attempted to prepare a comprehensive manual on 'Environmental Management Audits' which covers Environment audit, Green Campus Audit, Energy Audit and Hygiene Audit to Lead Auditors those who are conducting audits on Environment Management perspectives. Moreover, the authors did not claim that this is our own original ideas and concepts. It is merely an outcome of the compilation of different Environment Management System audit processes and collected more information from environmental legislations and law, Energy Conservation Building Code and Indian Green Building Council. It gives us an immense pleasure to thank Nature Science Foundation, Coimbatore, Tamil Nadu, India for offering an opportunity to write a comprehensive manual on 'Environmental Management Audits' which is copyrighted and published through proper channels.

Words are inadequate to express my sincere thanks to Chairman, Vice-Chairman, Secretary, Joint Secretary, Treasurer, **Dr. P.V. Sreenivasan**, Director **Mr. Anoop Vijayan,** Director (International Relations), **Dr. D. Vinoth Kumar**, Joint Director, **Mrs. S. Priyadharsini,** Deputy Director and **Mrs. S. Vanitha**, Assistant Director for their constant encouragement and support in writing this manual very successfully.

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Dr. B. Mythili Gnanamangai
Dr. G. Murugananth
Dr. S. Rajalakshmi

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(AUTONOMOUS)
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1. GREEN CAMPUS AUDIT

Green audit procedures includes the definition of green audit, how to conduct green audit at educational institutions and industrial sectors as per the checklist of Environment Management Systems and International Standards on ISO 14001:2015 and Indian Green Building Council at 360' views? and understanding the principles and importance of various audits in the context of the organization and risk assessment. In addition, an overall idea about green audits groundwork, auditing techniques, audit/non-conformity report preparation and submission is provided in brief. It will be analyzed how to help the educational institutions and industries to maintain the ecofriendly environment and personal hygiene to various stakeholders and in what way the audit process supports the nation as a whole for the noble cause of environmental protection and nature conservation which in turn to enhance the quality of life to human beings (Arora, 2017).

Green campus audit is a type of assessment to ensure that the Institution and Organization campus is greenish in terms of planting a large number of trees and lawns in the campus. To ensure that the list of plants and animals / birds available in the campus, biodiversity conservation, water irrigation system, recycling of water, rain harvesting system, site preservation, soil erosion control and landscape management will be evaluated (Gowri and Harikrishnan, 2014).

First concept of Environment Audit was approved in the Earth Summit, Rio-1992. In Institutes practice like renewable energy varies from 60% to 30%, sewage treatment plants only 20% (Patil *et al.*, 2019). Green Audit is a tool of Management system used methodologically for protection and conservation of Environment and sustenance of Environment. Green youth Leadership is to comprehend the relationship with the plants and animals and make sustainable and concerted efforts to conserve it. Their active participation in becoming examples for others.

To ensure that the campus should be greenish in terms of planting a large number of herbs, shrubs and trees including lawns which in turn to reduce the environmental pollution, proper water irrigation system, natural topography or vegetation, biodiversity conservation, etc. implemented effectively for the benefit of the stakeholders. Similarly, in order to ensure the green campus, the environmental management system, maintenance of ecofriendly campus which lead environment clean and neat, solid state management, recycling of water, disposal of sewage and waste materials including electronic wastes and biomedical wastes, landscape management, plastic use, etc. in the campus should be implemented effectively for the benefit for the stakeholders.

The Environment Management System is the quantitative and qualitative data to track air, water and waste, and to gain actionable insights to improve the operational performance. It is used to maintain the clean and green environment that leads to the stakeholders. It provides a 360' view of a surrounding campus and makes it easy for Owners / Managers /

Environmentalists to collaborate, measure, control, and reduce environmental impacts. Finally it leads to enhancing the quality of life for human beings, animals and plants. Green campus initiatives are needed at present across the world due to change in environmental conditions, global warming and increasing human population. It aims to make a sustainable and environmental friendly campus to the stakeholders.

1.1. What is a Green campus?

Green campus is an area of the organisation or the organisation as a whole itself is contributing to have an infrastructure or development that is structured and planned to incur less energy, less water, less or pollution free, less or no CO_2 emission. In certain cases, the project zone of green campus can be self-reliable in terms of energy and water consumption and with higher ratings of the project zone they can complement or support in national energy and water needs as a part of the corporate social responsibility. The green campus capitalization may incur some little investment but the vision of green campus is to satisfy the organizational needs by its simple initiatives in a bigger vision to prevent the deterioration of environmental resources

In the present scenario, with multiple options on availability of all materials and gadgets with high carbon dioxide emission, the sole responsibility in choosing building materials and less emitting gadgets installed in the projected project area should be considered. In case the organisation has to use many of the materials that add up burden to the environment in terms of anything that disturbs the environmental cycle (in unavoidable circumstances), the organisation should have taken proper steps to neutralize or nullify its own emission and produce its own needs.

Green campus is nothing but environmental friendly practices and education combined to promote sustainable and ecofriendly practices along with user-friendly technology in the campus. It creates environmental culture, develops sustainable solutions to environmental problems and provides solutions to various social and economic needs (Wang *et al.*, 2013). It provides the concept of green building and oxygenated building which in turn useful to provide a healthy atmosphere. Proper strategies and planning budgetary process for clean and green campus is also playing an important role. Tool kit for members of staff and students for a sustainable green campus can be developed by using tools and resources from case studies and practices, which are intended to inspire, encourage and support educational institutions and industrial sectors to develop and implement their own transformative strategies (Suwartha and Sari, 2013).

Green campus audit is useful to detect and monitor sources of pollution, nature of vegetation and topology which emphasizes on management of all types of waste, energy, water, soil, etc. It was implemented in the USA in 1970 for the first time but India is first to implement environmental audit compulsory in later stages (Arora, 2017). Environmental auditing system began in the UK, China, Russia, Germany and France in the early 1980s, when

a handful of industrial companies, working independently and on their own initiatives, developed environmental auditing programmes as internal management tools to help review and evaluate the status of the company's operating units. It enabled managers, environmentalists and academicians, to check the compliance with

- National level Environmental laws and regulations
- State level Environmental laws and regulations
- Environmental monitoring system and assessment
- Corporate policies and implementation
- Industrial policy and development
- Environmental auditing programmes

1.2. Green campus Audit Procedures

Green campus audit is a structured process of documenting the credentials in terms of measurable, recording, accounting and investigating of used materials and its impact on the environment and its ecology. Green audit projects the best environmental practices and initiatives taken in the organisation at the prescribed site of audit that brings added value to the organisation in maintaining the ecofriendly campus. The first step of the audit is ensuring that the organisation has a central role in building the green campus, in order to validate the same.

- Apply application forms of the green audit to Nature Science Foundation, Coimbatore, Tamil Nadu, India who are the Authenticated Professionals for people qualified to investigate and evaluate the campus for validating the best environmental practices.
- Once the application process is over the Professional team of Auditors will have an in house visit to the mentioned site or organisation for its claim.
- On accounting all the green practices of the organisation or the mentioned site or project site a detailed report will be given by the Auditing Professionals and the marks will be awarded in the respective heads.
- The report will be certified and returned to the applicants. If they wish to claim with improved marks, they can re-apply with improved structures with a resting period of six months.
- If they wish to claim the neglected marks for, they should re-apply within seven days after the receipt of the detailed GAR (Green Audit Report).
- A check-list of the green audit process is made available in the Nature Science Foundation's website (www.nsfonline.org.in) which can be downloaded for the conduct of green audit to verify the claims as an internal audit.

1.3. Overview of the Green Audit Flow

a. How to establish a Green campus?

The campus needs to have a vision of self-reliability at the stage of designing itself. As there was no awareness about the green buildings and green practices, the concept of converting the go green campus arrived. The campus should have restructured its existing facilities in order to establish or follow the go green campus practices. The go green structures and establishments should have a record of minimum documentation of existing records for a three months period.

The Management of the Organization (Auditee) should be shown their inherent commitment towards making ecofriendly atmosphere through the green auditing and ready to

encourage all types of green activities. They should promote all kinds of green activities such as conduct of environment awareness programmes, campus farming, planting trees, maintenance of greening, irrigation, use of biofertilizers and avoidance of chemical fertilizers and agrochemicals on the campus etc., before and after the green auditing. The management should formulate 'Green and Environment Policies' based on green auditing report. A clean and healthy environment should enhance an effective teaching and learning process and provides a conducive learning environment to the stakeholders. They should create the awareness on the importance of environment through environmental education among the student members. Green Audit is the most efficient and ecological way to manage environmental problems. In general, the Management should take responsibility to maintain the campus which is completely free from environmental pollution which is useful for providing a pure with ecofriendly atmosphere to the stakeholders (Staniskis and Katiliute, 2016; Satean, 2017).

Green campus audit may be beneficial to the campus in improving the greenery activities which in turn useful to save the planet for future generation. Green campus audit is a kind of professional care and a simple indigenized system about the environment monitoring in terms of planting a large number of trees which is the responsibility of each and every individual who are the part of economical, financial, social, environmental factors. It is necessary to conduct green audit frequently at least once in three years in campus because students and staff members should aware of the green audit and its advantages to save the planet by means of 'Go green concept' and help the institution to set environmental examples for the community, and thereby to educate the young learners (Ribeiro *et al.*, 2017). Green audit is a professional and useful tool for an Organization to determine how and where they are maintaining the campus eco-friendly manner. It can also be used to implement the mitigation measures is a win-win situation for all the stakeholders and the planet. It gives an opportunity for the development of ownership, personal and social responsibility for the stakeholders.

b. Aims and objectives of Green campus audit

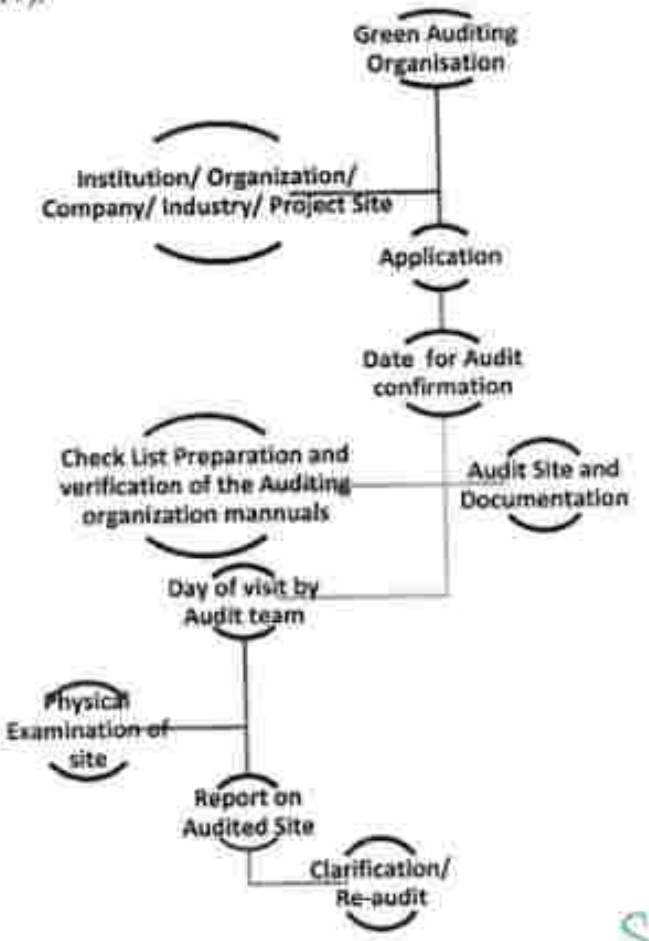
- To recognise the initiatives taken towards the environment and threat to the human health.
- To provide baseline information to assess threat and risk.
- To recognise, diagnose and resolve environmental problems.
- To identify the impact by the Institution on the Environment.
- To identify different pressures on the Institute to improve their environment.
- To ensure proper utilization of resources and the health and welfare of the community.
- To set a procedure for disposal of all kinds of wastes
- Green cover provides pollution free air, working as a carbon sink.
- Trees provide feeding points for birds and animals and provide shelter to them.
- A clean campus provides a hygiene place and Minimise waste and conserve water.
- Digital and automatic technology methods can reduce the consumption of paper, gas, water, energy, etc.
- Greenhouse gases emission is measured by software like Chevron Texco which is widely used in recent days. The reduction may be achieved by plantation, following no vehicle use in a day, use of bicycle, replacement of CFL bulbs with LED lamps, star

rated AC and Refrigerators, maximum natural lights, use of 15" monitors than 17-18" monitor, use of renewable energy (solar, water and wind), solid waste management, water management, hazardous waste management, E-waste management, etc.

- Facilitate India to be one of the global leaders in the sustainable built environment in coming years and enhance the quality of life significantly.

c. Definition of a Green campus audit

Green campus audit is a structured process of documenting the credentials in terms of measurable, recording, accounting and investigating of used materials and its impact on the environment and its ecology. Green audit projects the best environmental practices and initiatives taken in the organisation at the prescribed site of audit that brings added value to the organisation in maintaining the ecofriendly campus to the stakeholders. The green campus should have a large number of trees, shrubs, herbs, climbers, twiners and lianas which will provide a ecofriendly habitat to the mammals, birds, flies, moths, earthworms, amphibians, termites and various beneficial microorganisms in the soil and air. It will lead to give a pure atmosphere without any environmental pollution to the stakeholders in a sustainable manner (Ounsaneha *et al.*, 2017).



Flow chart of an audit process

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d. Benefits of the Green Auditing

There are several benefits on conduct of green audit by the Organization which may be definitely useful to improve the campus significantly after receiving the report of audit (Marrone *et al.*, 2018). The green campus audit contained methodology followed and both qualitative and quantitative measurements including physical observation of greeneries in terms of growing of terrestrial and aquatic plants, animals and microflora in the campus. The natural and planted vegetation and their maintenance are also considered in the organization campus through topography, landscape management design and soil erosion control in environment sustainable development. The following are the major benefits of the green auditing.

- Know the status of development of internal and external Green campus audit procedures and implementation scenario in the Organization.
- Establishment d Green campus objectives and targets as on today as per the 'Green and Environment Policy', 'Indian Biodiversity Act' and 'Wildlife Protection Act' of the Ministry of Environment, Forests and Climate Change, New Delhi and World & Indian Green Building Council concepts.
- Assigning the roles and responsibilities of Environmental Engineer and Agriculture Staff to give to improve green initiatives.
- Development of ownership, personal and social responsibility for the Organization and its environment and developing an environmental ethic and value systems to young generations.
- Enhancement of the Organization profile and reach the global standards in proving the green campus and eco-friendly atmosphere to the stakeholders
- Improving the drinking water / RO water / Bore well water / Open well water / Pond water / Municipal or Corporation water quality through the analysis of Physico-chemical properties of water.
- Creation of wastewater treatment facility and solid waste management provision in the campus for recycling of wastewater and solid wastes to minimize the air, water and soil pollution.
- Suggested of availability of Biogas plant to the management to restrict the usage of fossil fuel in cooking purposes.
- Implementing status of the rain harvesting system, water reservoirs, percolation pond, etc. in the campus to increase the ground water level.
- Establishment of terrace garden, herbal garden, kitchen, zodiac, ornamental gardens, etc. for enhancing teaching and learning and commercial exploitation.
- Treated water consumption towards plant cultivation, canteen, hostel, machinery cleaning, transport, toilet use and etc. on water consumption and per capita water consumption per day calculation.
- Studying the campus flora by making a complete data on total number of both terrestrial and aquatic plants, herbs, shrubs, climbers, twins and grasses.
- Survey of campus fauna by conducting the number living and visiting animals, insects, flies, moths and worms in the campus.
- Documentation of the number of oxygen producing and carbon dioxide absorbing plants planted in the campus to give pure atmosphere to the stakeholders.
- Operation of water irrigation, drip & sprinkler irrigation methods to improve the campus.

- Studying the biodiversity conservation through Life Sciences and Biological Sciences people to conserve economically important, rare and endangered plant and animal species in the campus ecosystem.
- Recommendation in use of biofertilizers, organic and green manures, cow dung manures and farmyard manures for the cultivation of plants to protect the environmental health
- Conduct of outreach programmes for dissemination of Green Campus motto and Green pledge initiatives to rural, tribal and urban people through Eco club, Nature club, Science club, Fine Arts club, Youth Red Cross unit, NCC and NSS bodies.
- Academic credentials like major and minor Projects, Dissertations and Thesis work on green campus, environment protection and nature conservation by the students and staff members.
- The plants available in the campus must be tagged with their common name and Botanical name for the stakeholders to impart the knowledge on medicinal and ornamental, economic and food values of plant varieties.
- MoU may be signed with Government and non-Governmental Organizations (NGOs) to utilize the resources for nature conservation and environmental protection.
- Implementation of Government schemes (Swatch Bharath Abhiyan under Clean India Mission) to give pure and safe water to rural people and teach the importance of cleanliness of toilets and restrooms.
- Conduction of awareness programmes and cultural activities on global warming, environmental changes and ecosystem maintenance to the stakeholders.
- Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods.
- Public transport, low-emitting vehicles and control of car smokes and exhaust towards carbon accumulation in the campus by carbon footprint studies.
- Implementation of advanced methods for watering plantations (Drip irrigation, Sprinkler irrigation, etc.) and use of metering for water utility, IoT based watering, automation, water device, remote water lines, etc.
- Percentage of Organization's budget for environment sustainability efforts and green campus initiatives planning and efforts.
- Campus facilities for disabled, special needs and or maternity care including security, safety and health infrastructure facilities for stakeholder's wellbeing.
- More efficient resource management, provide basis for improved sustainability and creation of plastic free campus to evolve health consciousness among the stakeholders.
- Impart environmental education through systematic environmental management approach and improving environmental standards by making a benchmark for environmental protection initiatives
- Best practices followed on green campus initiatives in the Organization listed and disseminated among the stakeholders.
- Recommendations for improving the green initiatives, planning and efforts in the campus after audit report to improve further.

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1.4. Procedures followed in Green Campus Audit

Green campus audit is a structured process of documenting the credentials in terms of number of trees, herbs, shrubs, lawns, climbers and lianas reflected in reducing the environmental pollution and soil erosion and useful for biodiversity conservation, landscape management, natural topography and vegetation. It is a kind of a professional tool for assessing the green campus. Green audit projects the best environmental practices and initiatives taken in the organisation at the prescribed site of audit that brings added value to the organisation in maintaining the eco-friendly campus to the stakeholders. The first step of the audit is ensuring that the organisation has a central role in building the green campus, in order to validate the same (Adeniji, 2008).

Green campus is not intended for the self-sustainability of the building alone, it also involves in propagation of the green campus initiatives so as to be adopted by any individuals and organization at a minimum cost. Green campus audit has been conducted as per the checklist of Nature Science Foundation, Coimbatore, Tamil Nadu, India (www.nsfonline.org.in) through the authenticated Professionals for people qualified to investigate and evaluate the campus for validating the best environmental practices. Professional team of ISO Environment Management Audit (14001:2015), Indian Green Building Council Accredited Professionals, Experts of Green campus Lead Auditors and Botanists / Zoologists / Biotechnologists were selected to conduct the Green campus audit process (Vinothkumar *et al.*, 2021).

During the audit, the nature of plants and animals / birds species present in the campus were recorded. Establishment of lawns, trees, herbs, shrubs and climbers and establishment of terrace / kitchen / herbal / zodiac / ornamental / medicinal garden / aquarium and aquatic (hydrophytes) plants in the campus were recorded. Labelling of common names and Botanical names of plants were observed. The operation of the water irrigation system, trip and sprinkler irrigation methods and use of recycled water for irrigation purpose or any other purpose in the campus area were noted. The number of water wells, bore wells and water reservoir facilities in the campus were also noted as per the Audit Manual of Gnanamangai *et al.* (2021) and Vinothkumar *et al.* (2021).

Attempts made for water scarcity during summer season towards the maintenance of plants and frequency of watering for plantations in the campus were noted. Biodiversity conservation education, projects, awareness programmes, etc., through Indian Biodiversity Act and Ministry of Environment, Forests and Climate Change, Government of India and the conduct of outreach programmes for dissemination of Green campus motto were recorded (Venkataraman, 2009). Conduct of outreach programmes for dissemination of Green campus motto to the students and staff members including public domain and signing of MoU with Government and Non-Governmental Organizations to ensure green campus activities for future generation were noted. Technology driven solutions initiated by the Green campus organization can also be disseminated and documented successively for propagating the attitude of the Green campus in wider masses.

Projects, Dissertations and Thesis are the academic effort credentials that always fosters the innovative ideas on thinking and implementation of new innovative approaches

towards the green campus. These should be disseminated through presentations and publications in social media, books, magazines and journals so as to spread the innovative ideas and methods to the broad public. These efforts taken by the students and staff were deliberated while conducting the Green campus audit. Green audit processes are taking place as per the following flow-chart starting from the receipt of application forms from the auditee (organization) and ending upon the submission of final report to the concerned organization within 15 days. During the audit process, the best environmental / greenery practices followed and new initiatives undertaken in the organisation to reduce the environmental pollution and steps taken for nature conservation that brings added value to the organisation in maintaining the eco-friendly campus to the stakeholders were assessed (IGBC, 2021; WGBC, 2021). In addition, the role of students and staff members in supporting the vision and mission of the greenery activities of the Organization is also assessed.

The purpose of the green audit is to ensure that the practices followed in the campus are in accordance with the Green and Environment Policy developed by the Government and private agencies working with environment sustainable development adopted by the institution. The criteria, methods/procedures, checklists and recommendations used in the audit were based on the identified risks (Ribeiro *et al.*, 2017). The methodology includes: preparation and filling up of questionnaire along with checklists, physical inspection of the campus, observation and review of the document, interviewing responsible persons and data analysis, measurements and recommendations (Leal Filho *et al.*, 2015). The methodology adopted for this audit was a four step process comprising of data collection, data analysis, best practices followed in the campus and recommendations and suggestions given to the organization to improve the greeneries practices further (Rajalakshmi *et al.*, 2021a and 2021b).

1.4.1. Onsite Green Campus Audit activities

1. The opening meeting is the first step between the audit team and auditee. In this meeting, the purpose of the audit, the procedure is to be followed for the conduct of the audit, document verification and the time schedules were discussed in brief along the Management Representatives.
2. Site inspection is the second step for onsite activity. In this step, the Audit team members visited different sites in campus and sufficient photographs were taken then and there for preparing the audit report.
3. During the onsite phase of visit, it is vivid how the various facilities made by the Management to the stakeholders without disturbing the landscape, natural topography and vegetation to ensure the green campus.
4. It is observed how the environment is protected in the campus and by what means an eco-friendly atmosphere is being given to the stakeholders. It is assessed the strengths and weaknesses of the Auditee's Management controls and risks associated with their failure in Green campus facilities were recorded.
5. Gathering audit evidence *ie*, collecting data and information from the auditee as per the audit protocol were carried out.
6. An exit meeting was conducted to explain the findings of the audit with the Management Representatives and staff members along with the audit team in brief.

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1.4.2. Pre-Audit stage activities

A pre-audit meeting (opening meeting) is conducted with Management and Administrative people along with staff coordinators of Energy and Environment audit process, wherein, audit protocol and audit plan were discussed in brief. The purpose of this meeting is to provide an opportunity to reinforce the scope and objectives of the audit and discussions held on the practicalities associated with the audit. Pre-audit stage activities are an important prerequisite for the green audit to meet the auditee and to gather information about the campus and necessary documents were collected directly from the Organization before the initiation of the audit processes. Audit team was selected by the Nature Science Foundation as per the checklist comprised of Lead Auditor of ISO (QMS 9001:2015 and EMS 14001:2015), Botanist, Agriculture and Horticulture Scientists from Conventional and Technical Universities across India, Accredited Professionals from Indian Green Building Council, Hyderabad and Associated Chambers of Commerce and Industry of India, New Delhi.

1.4.3. Target Areas of Green Auditing

Green campus audit is nothing but a professional tool to assess the greenery activities in the educational institutions and give a value addition to the campus and considered as a resource management process. Eco-campus concept mainly focuses on the efficient use of energy and water; minimize waste generation or pollution and also economic efficiency. Green campus audit process may be undertaken at frequent intervals and their results can illustrate improvement or change over time. Eco-campus focuses on the reduction of carbon emissions, water consumption, wastes to landfill and enhance energy use conservation to integrate environmental considerations into all contracts and services considered to have significant environmental impacts. The green campus auditing is to measure the number of plants covering trees, shrubs, herbs, climbers, twiners and lianas and animals covering mammals, birds, flies, moths, earthworms, amphibians and termites.

There are several target listed in the Green audit process in which a few are taken into consideration as per the Indian scenario is concerned. They are water use efficiency, energy use efficiency, solid, e-waste biomedical, food, sewage waste management and reuse methods, planting of oxygen producing and carbon dioxide absorbing pants, landscape management, topology, vegetation, soil erosion control, carbon footprint due to use of vehicles, electricity and fossil fuels. drinking water quality supply, Biogas plant, rain harvesting system, water reservoirs, percolation pond, establishment of various herbal, terrace and ornamental, gardens, campus and flora fauna, water irrigation, implementation of Government schemes, conduction of awareness programmes management, public transport, low-emitting vehicles and control of car smokes and exhaust, Organization's budget for greenery activities, campus facilities for disabled, special needs and or maternity care, security, safety and health infrastructure facilities for stakeholder's wellbeing.

1.4.4. Study area of Flora and Fauna diversity

The audit site should be quite clean, green and has much less pollution to the rest of the places. The campus is important not only from education and product development point of view but also as green lung. It is frequently visited by several nature enthusiasts to study the floral and faunal aspects. Biodiversity provides a useful measure of the quality of the environment and the ecological studies are important aspects of environment, in view of the

consideration of environmental quality and protection of natural flora and fauna. Similarly, topography is also very important with respect to the floral and faunal diversity studies. In the case of topology, altitude, longitude and latitude are equally important in terms of natural flora and fauna diversity. Similar to that of topology, geology and soil conditions are playing important in green campus establishment. The study area of audit site has a predominant red soil impregnated with good organic matter, water holding capacity and granite, bed rock is overlaid with shallow, sandy loam and glacial soils are moderate to well drain which in turn to support natural flora and fauna. Climatic conditions such as maximum and minimum temperature, maximum and minimum relative humidity, average annual rainfall, mean sunshine period and wind speed during summer and winter period covering both south west and north east monsoon periods are playing pivotal role.

1.5. Documentation of Green campus development

Any organisation that ensures green campus should have detailed documentation on the following heads that meets the environmental objectives. The green campus should document the number of trees, shrubs, herbs, climbers, twiners and lianas and animals such as the number of mammals, birds, moths, houseflies, amphibians and termites.

Accounting on Greenhouse gas emission: CO_2 emission details in the campus accounting the direct and indirect sources need to be documented well in terms of usage, period of usage (hour), the number of persons practicing the emission, personnel availability inside the campus, operating time of each equipment in the campus, has to be documented. The carbon footprint data can be calculated based on the usage of electricity, usage of vehicles, usage of GHGs emitting equipment, consumption of fuel for generating electricity, food and other work occurring. The accounting on green practices related to neutralization of carbon footprint should be documented periodically. The possible reduction of greenhouse gas emission can be achieved by enhancing the agricultural practices, usage of free energy, usage of equipment with no greenhouse gases (GHGs) emission, implementation of vehicle free zone, no electricity day, carbon free zone should be accounted and documented well (Table 1).

Accounting on Energy conservation and management: Frequent energy audits or daily energy audits help to maintain the record on their energy consumption. Separate metering for individual blocks helps to identify the energy consumption and leak. The reduction in the consumption of power leads to good green campus development. Documentation on using the less power consuming appliances like higher star rated refrigerators and air coolers must be used. Usage of CFL (Compact Fluorescent Bulb), LED (Light Emitting Diode) bulbs and solar lamps should be accounted properly. Building structures should minimize energy usage and leak proof. Highly ventilated building structures and usage of less energy devices can be documented well. Any practices to reduce the energy consumption can be reviewed and documented as well (Table 2).

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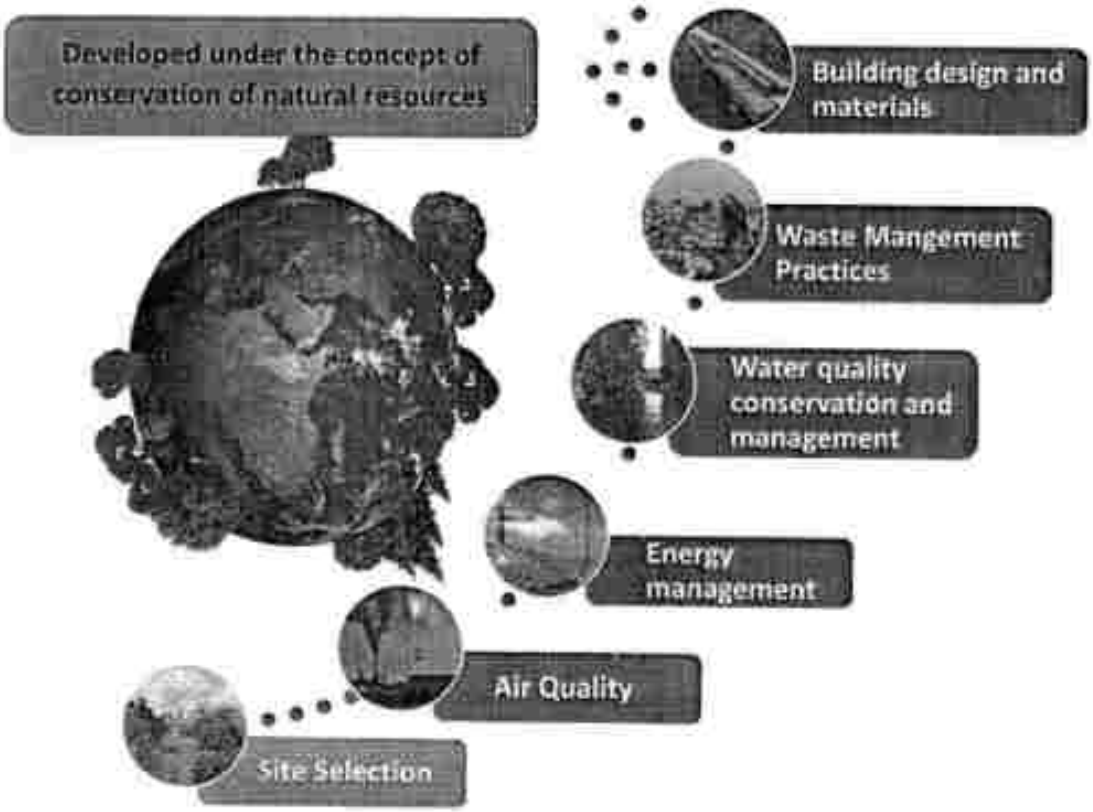

Key steps for 'Go green' concept at an Organization

Accounting on Water conservation: Metering on water usage and use of fixtures and appliances that consume less water should be documented. Practices like water usage accounting on every need in individual blocks can help to reduce the water usage. Practices like rainwater harvesting, watershed management and accounting should be documented. Establishment of a water recycle unit, its capacity and needs of recycled water along with the quantity should be recorded. Determination of recycled water quality should be documented well in order to maintain a safe and hygiene atmosphere. Special initiatives like recycled water for enriching the ecology, water conservation practices should be well documented and practiced effectively. Accounting on 3R water use efficiency, water efficient plumbing fixtures enabled with dual flow faucet, sensors that prevent leak and over flow tankers, metering devices, rain water consumption and purification systems to improve water quality considerably (Table 3).

Waste management practice: Innovative practices related to waste segregation and management must be accounted well for any organization to have a green campus role. Many categories of wastes like hazardous and E-wastes released from the green campus should be as minimum as possible in terms of harmful impact. If the organization pertains to release of

hazardous wastes, they should have a stringent methodology adopted for its management and release to the environment. If the organization is an academic Institution, then the practice related to the usage and disposal of the harmful chemicals and harmful wastes should be well documented in their laboratory usage and release. Proper sanitation, management and disposal methods will be accounted and their function should be transparent so as to be adopted and practiced effectively. In case of E-waste management, although reduced usage of electronics and refurbishing activities plays a major role in the green campus audit, practice of any level of e-waste management and innovative contributions to the society as well should be documented and accounted in terms of adoption of the practices in their own academic as well as non-academic Institutions (Table 4).

Indoor environmental quality: It relates to the well-being of the personnel with respect to the ambience of the environment. The indoor infrastructure should provide proper light, heat and ventilation for maintaining a good indoor quality to the stakeholders. Indoor ambience is accounted in terms of breathing zone in the air-conditioned room that relates to indoor humidity and age of indoor structure (Table 5).

Green Building materials: As of the accounting on the building materials the transportation on the recurring materials must be documented in terms of frequency of storage and the availability of the materials. Green campus auditing also complements the practices of utilizing the resources nearby and requiring materials from a consent which practices the 'go green' concept (Table 6). The green building materials should be user-friendly without causing any adverse effect to the environment as well as to human beings. Moreover, if the materials are stored for a long time, the material strength as well as quality of those materials should not be lost. During the transportation of green building materials, the materials should not harm the environment and strength and quality of materials should not be mislaid.

Table 1. Practices for reduced Greenhouse gases emission

Sl. No.	Salient features at a Project site / Audit site	Details of Implemented, Working and Documented (Site 1)	Details of Implemented, Working and Documented (Site 2)	Details of Implemented, Working and Documented (Site 3)	Not Impleme nted / No record
1.	Refrigerators without CFC				
2.	Air conditioners with high star ratings				
3.	Air conditioners without CFC				
4.	Software for carbon footprint calculations				
5.	Manual accounting on carbon footprint				
6.	Number of plants at site of inspection				
7.	Area for vegetation and topology				

Table 2. Energy management strategies

Sl. No.	Features at project site X No's	Implemented, working and documented X No's	Implemented, working and not documented X No's	Implemented, not working and not documented X No's	Not Implemented
1.	CFL (Compact Fluorescent Bulb)				
2.	LED (Light Emitting Diode)				
3.	Zero watts				
4.	LED Monitor/ total monitors				
5.	Separate energy meter				
6.	Refrigerators with higher stars				
7.	Air coolers with higher stars				
8.	Air conditioners with high star ratings				
9.	Machineries with higher stars				
10.	Occupancy sensor and timer				
11.	Automation and device development				

Table 3. Water conservation strategies

Sl. No.	Features at project site X No's	Implemented, working and documented X No's	Implemented, working and not documented X No's	Implemented, not working and not documented X No's	Not Implemented
1.	Dual mode faucet				
2.	Aerated taps				
3.	Water meter				
4.	Water recycle plant				
5.	Water conserving plantation				
6.	Rainwater harvesting unit				

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7.	Rainwater purification system				
8.	Rainwater table				
9.	Water shed management system				
10.	Sensor based water fixtures				
11.	Leak sensors				

Table 4. Waste management strategies

Sl. No.	Features at project site X No's	Implemented, working and documented X No's	Implemented, working and not documented X No's	Implemented, not working and not documented X No's	Not Implemented
1.	Solid waste management				
2.	Composting unit				
3.	Waste collection bins with colour codes				
4.	Waste Recycle unit installed				
5.	E-waste management record maintenance				
6.	Hazardous waste management				
7.	Usage of green chemicals for experiments				
8.	Innovative practices adopted				

Table 5. Indoor air quality

Sl. No.	Features at project site X No's	Implemented, working and documented X No's	Implemented, working and not documented X No's	Implemented, not working and not documented X No's	Not Implemented
1.	Breathing zone				
2.	Volatile organics				
3.	Non-irritant sealants				
4.	Non-irritant paints				

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Table 6. Green Building materials

Sl. No.	Features at project site	Implemented, working and documented	Implemented, working and not documented	Implemented, not working and not documented	Not Implemented
1.	Landscape details				
2.	Wild tree species				
3.	Wild type plantations				
4.	Wood usage certification				
5.	Recurring availability				
6.	Recurring storage				
7.	Green certified materials				
8.	Certified Auditors to take care of activities				

1.6. Practice of a Green campus Audit

A fresh green campus audit is required for any new (or) old organization to self-evaluate one's needs with respect to environmental objectives and implementation. In order to have a continuous monitoring and implementation of self-sustainable practices, green audit has to be practiced once in a year with updated practices and with consistent improvement in all the mentioned sections of protecting the environmental objectives. Mere practice and insist on a green campus audit is to create a self-sustainable organization that doesn't affect the nature and assist in protecting the natural resources, earth, ecology and biodiversity (Venkataraman, 2009). The audit helps to assess the strength and weakness of any organization on their self-sustainability in long run in terms of green campus planning and efforts (Aruninta *et al.*, 2017).

The Indian Green Building Council (IGBC) is a division of the Confederation of Indian Industry (CII), which was setup in the year 2001. It is coming under the Confederation of Indian Industry (CII) to create and sustain an environment conducive to the development of India as a whole and civil society through advisory and consultative processes. The vision of the Green Building Council is, "To make a sustainable environment for all and facilitate India to be one of the global leaders in the sustainable environment by 2025". The council offers a lot of services which encompass developing new green building rating programmes, green building training programmes and certification services. The council is based on a committee, driven by members and consensus-centred. All the stakeholders of the building industry like architects, developers, product manufacturers, Government, academia and nodal groups take part in the council activities through nearby chapters. The council additionally works with several State Governments, Central Government, World Green Building Council, bilateral multilateral businesses in promoting green constructing standards in the nation to provide ecofriendly atmosphere to everyone.

The IGBC and WBBC regulates, promotes, and educates the organization for implementing green building practices across India. IGBC also conducts examinations to qualify the accredited professionals for green campus auditing. It also provides membership to individuals to promote sustainability and environment through green building practices. It looks after and rates the organization starting from the designing of the project site to its implementation. Moreover, IGBC recognise the initiatives taken towards the environment protection and offer solutions to various environmental problems (IGBC, 2021 and WGBC, 2021).

Green campus audit practice and benefits

1.7. Conduct of Outreach Programmes for Dissemination of Green campus Motto

Wildlife Protection Act 1972 was enacted on 9th September, 1972 by the Parliament of India to protect the wild animals, birds, and plant species to the maximum extent. The green campus or green law is not accorded to any section of this Act. However, the indigenous flora and fauna should not be disturbed in the green campus, especially the landscaping and the pathways surrounding the green campus should be rich in indigenous wild varieties of plants, birds and animals. The structures promoting the access of the same will be accounted for the recognition of the green campus.

Awareness programme on the green campus initiatives needs to be accounted in a sustainable manner. Its benefits and self-sustainability can be projected for wider centric on earth and ecology conservation. Innovative practices that add up credentials in implementing the green campus which needs to be promoted in the awareness programme to the students and staff members including public domain (Adeniji, 2008). Technology driven solutions initiated by the green campus organization can also be disseminated and documented successively for propagating the attitude of the green campus in wider masses.

Green campus is the certification that needs appraisal and technology dissemination for conserving the nature for future generation. The innovative technology developed in an organisation for the purpose of sustainable green buildings needs a wide dissemination plan. Besides the advantage of the sustainable green buildings, it is less popular and hence must reach its popularity to the public. The technology developed at one organization can even be made public at an affordable design cost for any newly proposed to construct green buildings.

Promoters of green building technologies that are due to afford sustainable buildings should create awareness to the industry, organization and any young entrepreneurs. Technology dissemination plan, awareness on green campus concept, service learning and social responsibility activities need to be planned properly to align to the objectives of the green campus (Cardozo *et al.*, 2019).

- Technology dissemination includes newer ideas implemented in the green buildings that promote energy conservation, water conservation and environmental air quality management, usage of green building materials, waste management and renewal technologies and practice with respect to reducing the greenhouse gas emission.
- Service learning and social responsibility in developing new technologies with identified problem statements of an existing organisation to adopt green practices and dissemination of the same to be followed as the principles of green campus.
- Green campus is not intended for the self-sustainability of the building alone, it also involves in propagation of the green campus initiatives so as to adopt by any individuals and organization at a minimum cost.

Project and dissertation works are academic effort credentials that always fosters the innovative ideas on thinking and implementation of new innovative approaches. Twenty percent of the project in the organizations should be accounted in the areas of green building practices either directly or indirectly. Applied research work of the faculties and staff members should be implemented within the campus owing to the credential of the research. Those works indicating the significance of empowering the green campus can be implemented or adopted in other organizations. If the innovation is capable of developing into entrepreneurship, then it is highly appreciable (Cardozo *et al.*, 2019). The Report of projects and dissertations which are productive in methodologies should be disseminated through presentation and publication in social media, books, magazines and journals so as to spread the innovative ideas and methods to the broad public.

1.8. Role of Plants, Animals and Microorganisms in Green campus

Ensuring the rich biodiversity in the green campus is an important parameter. Plants are indicators for assessing the varying levels of environmental quality. In general, plants improve the outdoor air quality with increased oxygen levels and reduced temperature and carbon-di-oxide. The green and varying colour of the flowering plants improve the ambience of the environment. The record on maintenance of the plant biomass and its management are important with respect to green campus initiatives. The plants in the environment should account for 75% wild or native plant traits in the green campus. The native plant traits promote the indigenous fauna at the site area. Hence the accountancy of 75% of the wild traits are leveraged for the native animals and birds to a particular region. The existence of such animals and birds in the green campus can be recorded for the rich flora and fauna in the proposed site which are considered as a value addition to the campus. Similarly, accountability of the total beneficial microbial populations such as nitrogen fixing, phosphate and potassium solubilizing bacteria, fungi and actinomycetes are also considered for the rich biodiversity in the campus (Choy and Karudan, 2016). All these groups of microbes are essential accounts for a healthy biodiversity existence and conservation. Microbial population in the green campus site should be reported if possible periodically. The utilization of bacteria, fungi and actinomycetes inside

NATURE SCIENCE FOUNDATION

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APPLICATION FOR GREEN CAMPUS AUDIT TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference Number	NSF/GCA2021/Orgn.Name/ dated:
Name of the Organization & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:
Purpose	To ensure that the campus is greenish in terms of planting a large number of flora and fauna which in turn to reduce the environmental pollution, proper water irrigation system, natural topography, forest / planted vegetation, biodiversity conservation, green cover areas, etc. implemented effectively for the benefit of the stakeholders. Green youth Leadership, green practices, social responsibility and Institutional values are to comprehend the relationship with the plants and animals and make a sustainable environment.

PROCEDURE

Procedure	Description	Responsibility
Annual plan	Each year a plan for the Green campus audit is prepared by Management and to ensure that the environmental management system and ecosystem service are implemented in the campus.	Management Representative
Walk-through Audit	Based on the checklists, the Green campus audit is carried out in the form of observations in the campus.	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration.	Green Campus Coordinator
Reporting and Recommendations	Submission of corrective action in the form of report in association with Eco club / Student Chapters of the Institute.	Lead Auditor ISO 14001:2015 EMS Auditor

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Maisammaguda, Dhulapally, Kompally, Hyderabad-500 100

I. Requirements of General feature about the Strength of an Organization

1. Total Area_____, Building constructed area_____, Open area
2. Year of establishment:
3. Total Strength of Students:_____ (No. of Boys_____ and No. of Girls_____)
4. Total Strength of Hostellers: _____ (No. of Boys_____ and No. of Girls_____)
5. Total Strength of Teaching Staff: _____ (No. of Males____and No. of Females___)
6. Total Strength of Non-Teaching Staff:___(No. of Males___and No. of Females___)
7. Total Strength of Employees: ___(No. of Males___and No. of Females___)
8. Year of previous NAAC Accreditation:_____ Grade Obtained: _____
9. The ratio of open space area to total area:
10. Total area on campus covered in forest vegetation and planted vegetation:
11. The total open space area divided by total campus population:

II. Qualitative Measurements

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have internal Green campus audit procedures been developed and implemented in the Organization?			
2.	Have programmes for the achievement of Green campus objectives and targets been established and implemented as on today?			
3.	Whether Green campus audit and Environment audit are simultaneously carried out or separately carried out?			
4.	Whether Indian Biodiversity Act as per the Ministry of Environment, Forests and Climate Change, New Delhi, Wildlife protection act and World & Indian Green Building Council concepts followed?			
5.	Have responsibilities been assigned for programmes at each appropriate function and level? (Environmental Engineer & Agriculture Staff working for environment monitoring)			
6.	Are the following environmental aspects considered in sufficient detail?			
	a. Drinking water / RO water / Borewell water / Open well water / Pond water / Municipal or Corporation water use and to check quality of water through Physico-chemical properties analysis			
	b. Wastewater treatment facility			
	c. Sufficient number of trees, shrubs, herbs and lawns			
	d. Solid waste management facility			
	e. Availability of Biogas plant			
	f. Rain harvesting system, water reservoirs, etc			
	f. Aquarium and aquatic (hydrophytes) plants			
	g. Establishment of terrace garden, herbal garden, kitchen, zodiac, ornamental gardens, etc.			
	h. Natural Topography or Forest, Planted vegetation			

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	i. Water well, Bore well, lake, water reservoir facility			
	j. Water consumption towards plant cultivation, canteen, hostel, machinery cleaning, transport, toilet use			
	k. Treated water consumption towards plant cultivation, machinery cleaning, transport, toilet use and etc.			
	l. Per capita water consumption per day			
7.	Whether plants are tagged properly with their common name and Botanical name for stakeholders?			
8.	Signing of MoU with Govt. and NGOs to disseminate Green campus motto and pledge			
9.	Biodiversity conservation of plants, animals and wildlife, genetic resources (Endangered and endemic species) at each appropriate function and level?			
10.	Are any biofertilizers, organic manures, farmyard manures, vermicompost, green manures and chemical fertilizers used for maintaining plants?			
11.	Establishment of herbal garden, zodiac garden, medicinal garden, kitchen garden, terrace garden and ornamental plants garden in the campus			
12.	Implementation of Government schemes (Swatch Bharath Abhiyan under Clean India Mission)			
13.	Functioning of Nature club, Eco club, Cell, Forum, Association, NCC, NSS bodies and Social Service League for students and staff members on biodiversity conservation, green campus development, etc.			
14.	Conduction of awareness programmes and cultural activities on global warming, environmental changes and ecosystem maintenance to the stakeholders			
15.	Conduction of outreach programmes for dissemination of green campus initiatives, natural resources, environmental pollution and biodiversity conservation to rural, tribal and urban people			
16.	Implementation of composting pits, vermicompost unit, recycling of kitchen wastes collected from Hostels, Canteens, Cafeteria, Food court and other places			
17.	Maintenance of plantations in the campus and steps taken for water scarcity during summer season to maintain plants			
18.	Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods			
19.	Public transport, low-emitting vehicles and control of car smokes and exhaust			
20.	Observation on the site preservation, soil erosion control and landscape management			

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21.	Projects and Dissertation works and Scholarly publications on environmental science and management carried out by students and staff members			
22.	Implementation of advanced methods for watering plantations (Drip irrigation, Sprinkler irrigation, etc.)			
23.	Use of metering for water utility, IoT based watering, automation, water device, remote water lines, etc.*			
24.	Percentage of Organization's budget for environment sustainability efforts			
25.	Campus facilities for disabled, special needs and or maternity care including security, safety and health infrastructure facilities for stakeholder's wellbeing			

* Applicable for Industrial sectors
** A minimum of 50% criteria should be attained

III. Quantitative Measurements

S.No.	Details of Plant and animal species	Numbers
1.	Total number of Flowering plant species inside the Campus	
2.	Total number of Non-Flowering plant species inside the Campus	
3.	Total number of living Animals inside the Campus	
4.	Total number of visiting Animals inside the Campus	
5.	Total number of living Birds inside the Campus	
6.	Total number of visiting Birds inside the Campus	
7.	Total number of Aquarium	
8.	Total number of Aquatic (hydrophytes) plant species	
9.	Percentage of Forest Vegetation	
10.	Percentage of Planted Vegetation	
11.	Percentage of Water consumption to total human population	
12.	Percentage of Water consumption to total flora and fauna	
13.	Per capita water consumption per day	

Note: *This Audit process and Certificates are valid for three years only from the date of Audit.*

Signature of the Chairman

Signature of the Lead Auditor

Signature of the EMS Auditor
Environment Management System
(ISO 14001:2015, TUV NORD)

Signature of the IGBC / LEED AP Auditor
Indian Green Building Council
Leadership Energy and Environment Design

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APPLICATION FOR ENVIRONMENTAL AUDIT (ECO AUDIT) TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference Number	NSF/ECO/2021-22/Orgn.Name/ dated:
Name of the Organization & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:
Purpose	To ensure that the environmental management system, maintenance of ecofriendly campus which lead environment clean and neat, solid waste management, recycling of water, disposal of sewage and waste materials, landscape management, carbon footprint, zero emission vehicle policy, purchase policy for eco-friendly covers, etc. implemented effectively for the benefit of the stakeholders. Ecofriendly youth leadership, green practices, social responsibility and Institutional values are to comprehend the relationship with the ecosystem for sustainable environment.

PROCEDURE

Procedure	Description	Responsibility
Annual plan	Each year a plan for the Environmental audit is prepared by Management and to ensure that the environmental management system is implemented in the campus.	Management Representative
Walk-through Audit	Based on the checklists, the environmental audit is carried out in the form of observations in the campus.	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration.	Environmental Coordinator
Reporting and Recommendations	Submission of corrective action in the form of report in association with Eco club / Student Chapters of the Institute.	Lead Auditor ISO 14001:2015 EMS Auditor

PRINCIPAL
Sri Indu College of Engineering and Technology
(VIII): SHERIGUDA-501 510,

I. Requirements of general features

1. Total Area_____, Building constructed area_____, Open area
2. Year of establishment:
3. Total Strength of Students:_____ (No. of Boys_____ and No. of Girls_____)
4. Total Strength of Hostellers: _____ (No. of Boys_____ and No. of Girls_____)
5. Total Strength of Teaching Staff: _____ (No. of Males____and No. of Females___)
6. Total Strength of Non-Teaching Staff:___(No. of Males___and No. of Females___)
7. Total Strength of Employees: ___(No. of Males___and No. of Females___)
8. Year of previous NAAC Accreditation:_____ Grade Obtained: _____
9. The ratio of open space area to total area:
10. Total area on campus covered in forest vegetation and planted vegetation:
11. The total open space area divided by total campus population:
12. Ratio of ground parking area, carpet area and building constructed area to total campus area:
13. Total Number of vehicles of all stakeholders (No. of Buses:____, No. of Cars:____, No. of Motorcycles:_____, No. of Trucks:_____)

II. Quantitative Measurements

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have internal Environment audit procedures been developed and implemented in the Organization?			
2.	Have programmes for the achievement of environmental objectives and targets been established and implemented as on today?			
3.	Have responsibilities been assigned for programmes at each appropriate function and level? (Environmental Engineer & Agriculture Staff working for environment monitoring)			
4.	Are the following environmental aspects considered in sufficient detail?			
	a. Drinking water / RO water / Borewell water / Open well water / Pond water / Municipal or Corporation water use and to check quality of water through Physico-chemical properties analysis			
	b. Wastewater treatment facility			
	c. Hazardous and toxic material disposal facility			
	d. Solid waste management facility			
	e. Renewable energy utilization (Solar panel, wind mill, solar water heater, etc)			
	f. Air ventilation at Indoor / Outdoor auditorium, seminar / conference halls, classrooms, hostel, canteen, staff rooms, laboratories, restrooms, etc.			
	g. Acoustic proof in indoor auditorium, seminar / conference halls			
	h. Availability of Biogas plant			

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	i. Rain harvesting system, water reservoirs, etc.			
	j. Incinerator for napkin disposal use			
	k. Housekeeping, storage, areas, piping, plumping and etc. in a proper way			
	l. Sign boards indicating plastic free campus, tobacco free campus, don't waste water, don't walk on the lawns, don't plug flowers, etc.			
	m. The ratio of Environment sustainability courses (Environmental Science, Engineering, Technology, Management, Monitoring, Climate change, Global warming,) to total courses / subjects			
	n. Per capita water consumption per day			
5.	Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance			
6.	Implementation of Government schemes (Swachh Bharath Abhiyan under Clean India Mission)			
7.	Functioning of Nature club, Eco club, Cell, Forum, Association, NCC, NSS bodies and Social Service League for Students and staff members on environment conservation			
8.	Conduction of awareness programmes and cultural activities for environmental monitoring and ecosystem maintenance to the stakeholders			
9.	Conduction of outreach programmes for dissemination of natural resources and environmental pollution			
10.	Implementation of composting pits, vermicompost unit, recycling of kitchen wastes collected from hostels, canteens, and other places			
11.	Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods			
12.	Public transport, low-carbon emitting vehicles, battery operated vehicles, bicycles, biofuel use and control of car smokes and exhaust with respect to routine FC services			
13.	Observation on the site preservation, soil erosion control and landscape management			
14.	Projects and Dissertation works and Scholarly publications on environmental science, engineering, technology and management carried out by students and staff members			
15.	Steps taken to take care of daylighting, AC machine heat and carbon dioxide emission & carbon sequestration*			
16.	Eco-friendly Refrigerants, instruments and materials use including Energy efficiency measures taken *			

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17.	Mechanism of monitoring environmental parameters (Temperature, Relative humidity, Rainfall, Sunshine, Wind speed, dew point)*			
18.	Are the required resources (e.g. personnel skill development, procurement, finance, etc.) for implementation and control of the environmental management system provided by Management?			
19.	Any mosquitos and vectors and predators identified in the campus which are the root cause of various diseases spreading to students?			
20.	Any Digital / Automatic technology is adopted to reduce consumption of paper, gas, water, energy, etc.			
21.	Are all monitoring equipment appropriately maintained and calibrated?			
22.	Impactful Organization programmes on climate change, global warming, environmental protection, etc.			
23.	New initiatives to decrease private vehicles on campus to reduce carbon emission			

* Applicable for Industrial sectors
** A minimum of 50% criteria should be attained

Measurement of Carbon footprint in the Campus

The level of Carbon dioxide will be measured in different places across the Organization campus using a portable CO_2 Analyzer (Non dispersive infra-red meter). In addition, the atmospheric temperature, relative humidity and dew point will also be measured using the advanced automatic CO_2 Analyzer. Carbon footprint will be calculated based on the stage of calculation as stated in the www.carbonfootprint.com, which is the sum of electricity usage per year and transportation per year.

a. Electricity usage per year

The CO_2 emission from electricity
= (electricity usage per year in kWh/1000) x 0.84
= (0 kWh/1000) x 0.84 (is the coefficient to convert kWh to metric tons)
= 0 metric tons

b. Transportation per year (Shuttle)

= (Number of the shuttle buses in the Campus x total trips for shuttle bus service each day x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.01
= ((0 x 0 x 0 x 365)/100)) x 0.01
= 0 metric tons

Note:

365 is the number of working days per year
0.01 is the coefficient to calculate the emission in metric tons per 100 km for bus

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c. Transportation per year (Car)

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

= ((0 x 0 x 0 x 365)/100)) x 0.02

= 0 metric tons

Notes:

365 is the number of working days per year

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

d. Transportation per year (Motorcycle)

= (Number of motorcycle entering the Campus x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometres) x 365/100) x 0.01

= ((0 x 0 x 0 x 365)/100)) x 0.01

= 0 metric tons

Notes:

365 is the number of working days per year

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

e. Total Carbon dioxide emission per year

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

= 0 + (0 + 0 + 0)

= 0 metric tons

Reference of Set values of CO_2 level

- 350-1000 ppm: Typical level found in occupied spaces with good air exchange along with pure air.
- 1000-2000 ppm: Moderate level associated with complaints of drowsiness and poor air quality.
- 2000-5000 ppm: Critical level associated with headaches, sleepiness, and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may present.

Note: *This Audit process and Certificates are valid for three years only from the date of Audit.*

Signature of the Chairman

Signature of the Lead Auditor

Signature of the EMS Auditor
Environment Management System
(ISO 14001:2015, TUV NORD)

Signature of the IGBC / LEED AP Auditor
Indian Green Building Council
Leadership Energy and Environment Design

PRINCIPAL
Malla Reddy College of Engineering and Technology
(Vill): SHERIGUDA-501 510,
Ibrahimpatnam(Md), R.R.Dist.

NATURE SCIENCE FOUNDATION

[A Unique Research and Development Centre for Society Improvement]

APPLICATION FOR ENERGY AUDIT TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference Number	NSF/ENA/2021-22/Orgn.Name/ dated:
Name of the Organization & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:
Purpose	To ensure that the Organization is involving energy savings and consumptions towards the roadmap of the National development economy by assessing the electric current usage through Energy audit. As per the Energy Conservation Act, 2001, Energy Audit is needed for the verification, monitoring, conservation and analysis of use of energy efficiency with cost benefit analysis and an action plan to reduce energy consumption. Carbon footprint in terms of carbon dioxide emission due to electricity usage in the campus will be calculated

PROCEDURE

Procedure	Description	Responsibility
Annual plan	Each year a plan for the Energy audit is prepared by Management and to ensure that the environmental management system is implemented in the campus.	Management Representative
Walk-through Audit	Based on the checklists, the energy audit is carried out in the form of observations in the campus and report and recommendations are to be given to the concern Organization	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration.	Energy audit Coordinator
Reporting and Recommendations	Submission of corrective action in the form of report in association with Energy club / Student Chapters of the Institute.	LEED AP / BEE ISO 14001:2015 EMS Auditor

PRINCIPAL
Ai malu College of Engineering and Technology
(VIB): SHERIGUDA-501 510,
Ibrahimpatnam(M), R.R.Dist.

I. Quantitative and Qualitative Measurements

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have internal Energy audit procedures been developed and implemented in the Organization?			
2.	Have programmes for the achievement of energy efficiency and conservation objectives been established and implemented as on today in the campus?			
3.	Has a Management Representative, Electrical Engineer, Staff incharge been assigned for energy savings on power consumptions?			
4.	Have programmes for the achievement of prescribed financial outlay for current bills for each building in the campus towards power consumptions?			
5.	Has the organization ensured that personnel performing environmental specific tasks have the required knowledge on energy audit (e.g. education, training programme, seminar, workshop, camp, etc.)?			
6.	Are objectives and targets documented towards energy audit periodically and any Register is made?			
7.	Any analysis of energy flows for energy conservation in terms of the amount of energy input into the system without negatively affecting the output in buildings			
8.	Implications of alternative energy efficiency measures sufficient to satisfy the financial criteria of sophisticated investors			
9.	Identification of the most efficient and cost-effective Energy Conservation Opportunities (ECOs) or Measures (ECMs) taken by the Management			
10.	Are the following energy efficiency and conservation aspects considered in sufficient detail?			
	a. Fluorescent (tube) lights, Incandescent lamp and sodium vapour lights are replaced with CFL / LED lamps			
	b. Number of Uninterruptible power supply (UPS) and Power generators for power back-up to alternative current supply facility in each building			
	c. Number of solar panels, solar lights, solar water heaters, electric water heater installed			
	d. Automatic sprinkler system used for irrigation purpose			
	e. Ultra-violet lights and any other harmful lights used with safety precautions			
	f. Attempt in reducing the energy expense and carbon footprint			
	g. Disposal facility for hazardous arise from electrical gadgets, equipment and installation			
	h. Renewable energy utilization (solar panel, wind mill)			

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(VIII): SHERIGUDA-501 510,

	i. Natural / Mechanical air ventilation at Indoor / Outdoor auditorium, stadium, seminar halls, etc.			
	j. Sign boards indicating Switch OFF / ON, Danger at Electrical equipment and Power transformers in the campus			
11.	Signing of MoU with Govt. and NGOs to ensure about the energy conservation and efficiency in the campus			
12.	Conduction of awareness programmes and outreach programmes on the energy conservation and efficiency			
13.	The details of public transport, battery operated / electric vehicles, biofuel use, exhaust fans, boiling water system, chillers and geysers on energy savings mode			
14.	Projects and Dissertation works on the energy conservation and efficiency carried out by students and staff members			
15.	Steps taken to take care of daylighting, AC machines heat emission and ecofriendly Refrigerators, etc.			
16.	Use of water metering, IoT based energy efficiency practices, remote waterlines, automation of electrical fittings and gadgets to save energy			
17.	Are all monitoring electrical equipment appropriately maintained and calibrated?			
18.	Are any energy conservation technologies and retrofit for energy conservation equipment being implemented?			
19.	Skylight roof ratio, fenestration plan and Daylight illuminance in building construction towards energy efficiency*			
20.	Any Automatic Lighting Shutoff with occupancy Sensors and Timers, Exterior / Interior lighting control facility*			
21.	Have any rooms and guest suites a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles*			
22.	Total electricity usage divided by total campus' population (kWh per person)			
23.	The ratio of renewable energy production divided by total energy usage per year			
24.	Total carbon footprint divided by total campus' population (metric tons per person)			
25.	Elements of green building implementation as reflected in all construction and renovation policies			
26.	Greenhouse gas emission reduction awareness programme to the stakeholders			

* Applicable for Industrial sectors

PRINCIPAL
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(Vill): SHERIGUDA-501 510,
[illegible], R.R.Dist.

Power supply and Equipment, instruments and Machineries utility

S.No.	Major and Minor Equipment, Instrument and Machineries Utility on day-to-day basis	Rating / Capacity	Quantity (Nos)
1.	LED Tube Lights		
2.	Flouresecent Lamps		
3.	Halogen Lamps		
4.	Sodium Vapour Lamp		
5.	CFL		
6.	LED Focusing Light		
7.	Tube Lights		
8.	Solar Water Heater		
9.	Solar Panel		
10.	UPS		
11.	LCD Projectors		
12.	Refrigerators		
13.	Varanda Light load		
14.	Varanda LED Light Load		
15.	Solar Street Lights		
16.	Lift		
17.	Water Doctors		
18.	RO Water Plant & Water Purification System		
19.	AC (Split, Window and Centralized AC)		
20.	Stabilizers		
21.	Inverters & Converters		
22.	Air Cooler		
23.	Celling Fans		
24.	Pedestal Fans		
25.	Table Fans		
26.	Portable Fans		
27.	Generators		
28.	Pumps		
29.	Motors		
30.	Compressors		
31.	Vacuum Cleaner		
32.	Biogas Plant		
33.	Drip & Sprinklers Irrigation		
34.	Ventilators		
35.	Exhaust Fans		
36.	Insect Trap		
37.	Automatic Lights		
38.	Internet Connectivity		
39.	Podium containing Mike, Speakers, Amplifiers, Radio, Camera, Sensors, etc.		

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40.	Computers, Laptops, iPad, Dot matrix Printer Laser printers, Xerox Machines, Scanners, Server Fax machines, Inverter with UPS		
41.	**Equipment, Instruments and Machineries related to Life Sciences and Biological Sciences including Biotechnology, Nanotechnology, Food Technology, etc.** Electronic Balances, pH Meter, Hot-air-Oven, Microwave Oven, Laminar Air Flow, Autoclave, Microscopes, Refrigerators, Rotatory Evaporators, Centrifuges, Electrophoretic apparatus, Chromatography devices, Grinders, Mixers, Deep Freezers, BOD Incubator, COD Digester, Extraction apparatus, Incubators, CO_2 incubator, Heating Mantle, Vacuum pump, Vortex mixer, Magnetic stirrer, Gel rocker, Sonicator, Growth Chambers, Air curtains, Aerators, Spectrophotometers, Calorimeters, Turbidity meter, Colony Counter Water bath, Dry bath, Thermocycler, Gene gun, Gel Documentation System, Transilluminator, Ice maker, ELISA Reader & Washer, Aquarium, Zebrafish / animal house facility, Mechanical & Orbital Shakers, Cyclo mixer, Lyophilizer, Incinerators, Ammeter, Flame Photometer, Fluorimeter, Fermentors, Reactors, Particle size Analyzer, XRD, FTIR, Muffle Furnace		
42.	**Chemical Sciences and Engineering Equipment / Machines** Distillation Units, Flow through straight pipe, Packed bed distillation, Roll crusher, Jaw crusher, Sieve analysis machine, Shell and tube heat exchangers, Plate and frame filter press, Fume hood, Fluorimeter, Venturimeter, Orifice meter, Nephelometer, Membrane Filtration Apparatus, Sieve set machine, Jar test apparatus		
43.	**Electrical, Electronics and Communication Engineering Equipment / Machines** DC Shut motor, DC Series motor, DC Compound motor, DC Shunt motor, DC Compound generator, DC series generator, Single phase & Three phase transformers, Single phase & Three phase auto transformers, Loading rheostat, single phase & Three phase, Inductive & Capacitive load, Power electronics trainer kits, Three phase squirrel cage induction motor, Single phase & Three phase		

	induction motor, Three phase slip ring induction motor, AC generator, Stabilizers, Synchronizer, Half and Fully controlled converters, Buck, Boost and buck-boost converters, Single phase and Three phase inverters, Synchros, CRO, DSO, CRO, Microprocessor trainer kits, Microcontroller trainer kits, Arudino trainer kits, Digital electronics trainer kits, Flip-flops, Counters, Half adder, Full adder circuits,		
44.	**Mechanical Engineering Equipment / Machines** Lathe machine, Milling machine, Drilling machine, Slotting machine, Shaping machine, Cylindrical, Grinding, Coordinate Measuring, Universal testing devices, Thermal Conductor, Air Compressor, Single Cylinder 4 Stroke Diesel Engine, CNC Turning Centre, Kaplan, turbine, Pelton wheel turbine, Francis turbine, Venturimeter, Orifice meter, Nephelometer, CAD & CAM machines, Tensile strength apparatus, Younggus modules apparatus, XRD machines,		
45.	**Civil Engineering Equipment / Machines** Compressing testing machine, Universal testing machine, Loading Frame, Flow Cytometer, Total Station, Theodolites, Flexure testing machine, Sieve set, Slump cone apparatus, Compaction factor apparatus, Torsion testing & Izod impact testing machines, Hardness testing machine, Beam deflection test apparatus, Le Chateliers apparatus, Vicats apparatus, Centrifugal Pump, Gear Pump, Submersible pump, Reciprocating Pump, Pelton Wheel turbine, Francis turbines / Kaplon turbine, Conductivity meter, Jar test apparatus, BOD incubator, COD digester, Direct shear apparatus, Triaxial shear apparatus, Hydrometer, Relative Density apparatus, Vee Bee Consistometer, CBR Apparatus, Turbidity meter.		
45.	**Textile Technology Equipment / Machines** Ring spinning, Rotor spinning, Weaving machine, Ruti C loom, Circular Knitting machine, Curing chamber, Wash Fastness Tester, Streamer, Washing machine, Dryer,		

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Indu College of Engineering and Technology
(VIII): SHERIGUDA-501 510,
Ibrahimpatnam(M), R.R.Dist.

Measurement of Carbon footprint in the Campus

The level of Carbon dioxide will be measured in different places across the Organization campus using a portable CO_2 Analyzer (Non dispersive infra-red meter). In addition, the atmospheric temperature, relative humidity and dew point will also be measured using the advanced automatic CO_2 Analyzer. Carbon footprint will be calculated based on the stage of calculation as stated in the www.carbonfootprint.com, which is the sum of electricity usage per year and transportation per year.

a. Electricity usage per year

The CO_2 emission from electricity
= (electricity usage per year in kWh/1000) x 0.84
= (0 kWh/1000) x 0.84 (is the coefficient to convert kWh to metric tons)
= 0 metric tons

b. Total carbon dioxide emission per year

= total emission from electricity usage + transportation (bus, car, motorcycle, trucks)
= 0 + (0 + 0 + 0 +0)
= 0 metric tons

Reference of Set values of CO2 level

- 350-1000 ppm: Typical level found in occupied spaces with good air exchange / pure air.
- 1000-2000 ppm: Moderate level associated with drowsiness and poor air quality.
- 2000-5000 ppm: Critical level associated with headaches, sleepiness, and stagnant, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may present.

Energy Consumption and Cost Profile

S.No	Months	Cost in Rs.	Rating / Capacity
1.	January		
2.	February		
3.	March		
4.	April		
5.	May		
6.	June		
7.	July		
8.	August		
9.	September		
10.	October		
11.	November		
12.	December		

Note: *This Audit process and Certificates are valid for three years only from the date of Audit.*

Signature of Auditing Chairman **Signature of the Lead Auditor**

Signature of the EMS Auditor
Environment Management System
(ISO 14001:2015, TUV NORD)

Signature of the BEE / LEED AP Auditor
Bureau of Energy Efficiency
Leadership Energy and Environment Design

PRINCIPAL
Sri Indu College of Engineering and Technology
(Vill): SHERIGUDA-501 510,

NATURE SCIENCE FOUNDATION

[A Unique Research and Development Centre for Society Improvement]

APPLICATION FOR HYGIENE AUDIT TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS

Reference Number	NSF/HYA2021-22/Orgn.Name/ dated:
Name of the Organization & Address	
Date of Audit	
Name of the Lead and EMS Auditors	
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:
Purpose	To ensure that the hygienic environmental management system, maintenance of environmental and personal hygiene, availability of clean resources, maintenance of water and food supply and hygiene, cleanliness ensured at the site of disposal of human waste materials and personal safety in the campus are being implemented effectively. Hygiene audit will provide an insight into how an organization operates in a sustainable manner in terms of personal hygiene to the stakeholders.

PROCEDURE

Procedure	Description	Responsibility
Annual plan	Each year a plan for the hygiene audit is prepared by Management and to ensure that the entire hygienic environmental management system is implemented to ensure health and personal safety in maintaining hygiene to the stakeholders.	Management Representative
Walk-through Audit	Based on the checklists, the hygiene audit is carried out in the form of observations in the campus.	Audit team
Follow-up of action	Corrective action has to be undertaken and implemented within the prescribed duration.	Campus hygiene Coordinator
Reporting and Recommendations	Submission of corrective action in the form of report in association with the hygiene club / Student Chapters of the Institute.	Food Safety Lead Auditor EMS Auditor

PRINCIPAL
[illegible] College of Engineering and Technology
(Vill: SHERIGUDA-501 510,
[illegible]

I. Qualitative and quantitative measurements

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have internal hygiene audit procedures been developed and implemented in the Organization?			
2.	Have programmes for the achievement of personal hygiene and safety objectives been established and implemented as on today in the campus?			
3.	Other hygiene specific issues on site such as housekeeping, storage and availability of consumables, areas, piping, sanitation schedule and instruments			
4.	Whether the concepts of 'Food Safety Management System' and 'Food Safety Standard' are followed?			
5.	Has a Management Representative, Hygiene specialist, Food safety officer, Laboratory staff been assigned?			
6.	Are the following parameters considered in sufficient detail? (with proper sign board / instructions)			
	a. Wash room facility with liquid detergent, soap, towel, tissue paper roll, sanitiser, dryer, etc.			
	b. Hand wash facility with liquid detergent, soap, towel, sanitiser, etc.			
	c. RO, potable and drinking water facility			
	d. Napkin disposal facility with incinerators			
	e. Sufficient natural and mechanical ventilation facility			
	f. Practice of personal hygiene and safety measures			
	f. Practice of water recycling and management system			
	g. Analysis of water quality assessment			
	h. Implementation of advanced methods for waste disposal system and recycling			
7.	Whether food handlers, mainly canteen, hostel and restaurants, guest house employees, wear proper aprons, headgear, hand gloves etc.			
8.	Monitoring of efficient hand wash, urinals and latrine and bath room facilities in the campus.			
9.	Details of pest management strategies adopted (cockroach traps, rodents control measures, insect repellents and other control facilities)			
10.	Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance			
11.	Implementation of Government schemes (Swachh Bharath Abhiyan – Clean India Mission)			
12.	Functioning of personal and environmental hygiene Clubs and Forums to ensure hygiene campus			
13.	Conduction of outreach programmes for dissemination of healthy hygiene campus motto and their initiatives			

PRINCIPAL
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(VM): SHERIGUDA-501 510.
Ibrahimpatnam(M), R.R.Dist.

14.	Food supplies are obtained from licensed or approved sources and people*			
15.	Food preparation area is clean, free of insect pests and in a good state of repair along with proper water supply.			
16.	Number of Freezers, Chillers, Microwave oven, Grinders, Maxies, electric stoves and other equipment are neatly used*			
17.	Refreshment areas and dining halls, including walls and pillars are kept clean and free of insect pests including unwanted articles (e.g. carton boxes).			
18.	Fixtures (e.g. fans and lighting) and furniture (e.g. tables and chairs) are kept clean.			
19.	Projects and Dissertation works on environmental science and management carried out by students and staff members			

II. Personal hygiene, maintenance & sanitation measures undertaken

S.No.	Personal hygiene, maintenance & sanitation measures undertaken	Good	Satisfactory	Need Improvements
1.	No person suffering from a disease or illness or with open wounds or burns is involved in handling of food or materials which come in contact with food*			
2.	Food handlers maintain personal cleanliness (clean clothes, trimmed nails & water proof bandage etc.) and personal behaviour (hand washing, no smoking, no spitting etc.)*			
3.	Food handlers are equipped with suitable aprons, gloves, headgear, etc.; wherever necessary*			
4.	Cleaning of equipment, food premises is done as per cleaning schedule & cleaning programme. There should be no stagnation of water in food zones*			
5.	Preventive maintenance of equipment and machinery are carried out regularly as per the instructions of the manufacturer*			
6.	Pest control program is available & pest control activities are carried out by trained and experienced personnel*			
7.	No signs of pest activity or infestation in premises (eggs, larvae, faeces etc.)*			
8.	Drains are designed to meet expected flow loads and equipped with grease and cockroach traps to capture contaminants and pests*			

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Ibrahimpatnam(Md), R.R.Dist.

9.	Check food servants with worn of the jewellery ornamentals such as necklace, bangles, rings, earrings, nose pins, septum nose rings, anklets, bracelets, hair clips, etc.*			

III. Enumeration Microbial Population density at different places in the College

S.No	Assessment of Microbial load	Number of Microbes (cfu)	High / Moderate / Low*
1.	Number of bacterial, fungal and actinomycete colonies in Dining halls, Hostels, Food preparation and storage areas		
2.	Number of bacterial, fungal and actinomycete colonies in Canteen, Restaurants and Food court		
3.	Number of bacterial, fungal and actinomycete colonies in Seminar halls / Conference halls / Auditorium / Stadium regions		
4.	Number of bacterial, fungal and actinomycete colonies in Class Rooms and other teaching and learning places		
5.	Number of bacterial, fungal and actinomycete colonies in Laboratories		
5.	Number of bacterial, fungal and actinomycete colonies in Management Representatives / Vice-Chancellor/Registrar/Dean Principal/Director/HoD's Room/ Teaching / Non-Teaching staff Cabins/Coordinators, etc.		

* Applicable for Industrial sectors

** ** A minimum of 50% criteria should be attained

- *Greater than 25 cfu is high, 10-25 cfu is moderate, lesser than 10 cfu is low*
- *Microbial load as aeroflora will be counted using Petri plates containing Potato Dextrose Agar, Nutrient Agar and Casein Nitrate Agar Media for fungi, bacteria and actinomycetes; respectively. Microbial load will be assessed in air at the time of assessment in different places*

Note: *This Audit process and Certificates are valid for three years only from the date of Audit.*

Signature of Auditing Chairman

Signature of the Lead Auditor

Signature of the EMS Auditor
Environment Management System
(ISO 14001:2015, TUV NORD)

Signature of the Food Safety Auditor
Food Safety Management System
(ISO Safety Standards FSMS 22000)

PRINCIPAL
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(Vill): SHERIGUDA-501 510.
...(M), R.R.Dist.

NATURE SCIENCE FOUNDATION

[A Unique Research and Development Centre for Society Improvement]

APPLICATION FOR ACADEMIC AND ADMINISTRATIVE AUDITS TO EDUCATIONAL INSTITUTIONS

Reference Number	NSF/AAA 2022/ Orgn. Name/ Dated:
Name of the Organization & Address	
Date of Academic & Administrative Audit	
Name of the Lead Auditors	
Name of the Lead Auditing Chairman	
Is it a new Audit (or) renewal process?	New audit (or) Renewal audit, tick (√) any one. If it is a Renewal audit, mention the date of last audit:

Aim and major Objectives of Academic & Administrative Audit (AAA):

- The main aim of the Academic & Administrative Audit is to encourage reviews about the Educational Institutions from the peers that are inside and outside of the Institutions by visiting the sites and conducting a self-study about the processes carried out there.
- This helps them to ensure the quality of the standards in comparison with the previously set benchmarks by the NAAC / NBA/ other Accreditation Bodies. Further, the Institutes get an opportunity to understand the shortcomings and improve the quality of education of the various processes and systems of the Institutions.
- This includes evaluation of all the curricular and co-curricular programmes and activities which eventually helps the Institutes to maintain the high education standards on a long-term basis for future prospects.
- The purpose of the Academic and Administrative Audit is to evaluate the performance of the various Departments and Institution and give suggestions for further improvement of the quality of teaching, research, administration, and curricular and extra-curricular activities.
- It is useful to prepare a Self Study Report (SSR) for the purpose of Institution / Department grading which aims to encourage self-evaluation, accountability, research, and innovation in teaching and learning.
- It will also help to create healthy competition in curricular and extracurricular activities among the Institutions / Departments. The grading will be performed based on the valid documents and question wise as per the following criteria.

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Advantages of Academic and Administrative Audit (AAA):

The advantages of an academic audit are manifold such as, but not limited:

For Students: It helps in eliminating unnecessary workload and dwells mainly on those essentially required for the success of a student's career.

For Teachers: It helps in clarifying their roles and responsibilities and thus avoids conflicts.

For Employers: It ensures availability of well-rounded students who can contribute from day one itself.

For Administrators: It gives an insight into the overall quality of the institution including its strengths, weaknesses, opportunities and threats.

For Management: It ensures the proper use and effectiveness of the processes, systems, infrastructure, practices, infrastructure, HR and facilities in the practice of the institution and to implement corrective measures.

I. Academic Aspects

S.No.	Description of Records / Documents for Verification	Observations	Remarks
1.	Course file (Contents, Students Name list, Syllabus, Timetable, Teaching plan, Class test, Question papers, Class test marks, Internal test question papers, Formula sheet, Assignment Questions, 2 Marks questions with answers, Question bank, Question Bank, University Model Question papers, Lecture notes, Sample answer papers-high, moderate and low performers)		
2.	Daily Test, Internal Test – Papers & Assignments		
3.	Daily Test and Internal Test Marks		
4.	Web portal Entry details		
5.	Challenging Students List		
6.	Supplementary Education details for each Subject		
7.	Report of Absentees sent to Parents		
8.	Action taken for Absent in the Internal test		
9.	Supplementary Education for Arrear Students		
10.	Question Bank, Lecture Materials – in College Webportal & Questions papers (Class test and Internal test)		
11.	Laboratory Observation and Record book of students (sample)		
12.	Result Analysis of Odd / Even Semester University Examination		

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13.	Final year Project Review Marks		
14.	Class Committee and Tutor ward Meetings Minutes		
15.	Syllabus Completion Report (Theory & Practical)		
16.	Laboratory Weekly Report		
17.	Students Attendance & Undertaking Forms if any		
18.	Students Late coming Monitoring Register		
19.	Class Committee Meeting Students Representatives list (High, Moderate and Low Performers)		
20.	Discipline Committee Reports		
21.	Students Movement Register		
22.	Staff Attendance Register		
23.	Class Alteration Register		
24.	Staff Leave / Permission Register		
25.	Laboratory – Equipment Movement Register		
26.	Laboratory – Service Register & Stock Register		
27.	Parents visit Register		
28.	Students Profile along with Xerox copy of certificates		
29.	Students Leave Application & Leave Card		
30.	Students OD Application with reason		
31.	Students Counselling Recommendation & Report		
32.	Department Meetings – Agenda & Minutes		
33.	Incoming & Outgoing Letters Register		
34.	Subject Allocation for Faculty members based on Subject expertise		
35.	Work Load – Teaching & Non-Teaching		
36.	Lab Utilization and Allocation for Research activities		
37.	Feedback of Parents and Alumni		
38.	Laboratory / Workshop Maintenance Register		
39.	Safety & First Aid Equipment's including Fire Extinguisher		
40.	Lab Manuals & Record Note Books		
41.	Samples of Project Reports		
42.	Samples of Project Reports covering both Under Graduate and Post Graduates and Doctoral levels		

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II. Administrative Aspects		
S.No	**Description of Records / Documents**	**Remarks**
1.	Campus Area	
2.	Campus Ownership	
3.	Office Space	
4.	Area of Library	
5.	Security	
6.	Water facility	
7.	Power back up facility	
8.	Wash room facility	
9.	Parking facility	
10.	Class room	
11.	Staff room	
12.	Seminar room	
13.	Medical centre facility	
14.	Sports facility	
15.	Hostel (Boys and Girls)	
16.	Transportation of Students	
17.	Support services - Bank / PO / Reprography	
18.	Canteen	
19.	Approach road	
20.	Garden	
21.	Auditorium / Assembly hall	
22.	Internet facility	
23.	Stores	
24.	Water treatment plant	
25.	Eco-Friendly procedures	
26.	Administrative training for Administrative staff	
27.	Computer facilities	
III. Teaching and Learning Processes		
1.	Policy planning, monitoring & evaluation and promotional activities facilitated by the Departmental & Institutional level	
2.	Number of value-added certificate courses / Additional courses / Non-Formal course / Job oriented courses / Skill development courses offered till date by the Departmental & Institutional level	

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3.	Mention University ranks, if any, obtained for the academic year batches. (Give the total number of students appeared for the subject in the university)	
4.	Does the Department provide remedial coaching for tough subjects covering core and elective courses?	
5.	Does the Institution & Department employ any innovations in teaching and evaluation methods?	
6.	Did the Institution & Department design any curricula this academic year? How long it is being revised?	
7.	Does the Institution & Department conduct student and staff evaluation in semester wise?	
8.	Do the teachers complete topics according to the teaching plan suggested?	
9.	How many teachers attended seminars / workshops / conferences / refresher courses etc. during the academic year.	
10.	Does the Institution & Department use any modern tools and techniques in teaching and learning process?	
11.	Give details of faculty members, if any, who are selected as resource persons for seminars / workshops / conferences / refresher courses etc. during the academic year?	
12.	Does the Institution & Department conduct input-output analysis as survey?	
13.	Does the Institution & Department have publications out of the work done within the Department during the current academic year?	
14.	Is the Institution & Department recognized as a research centre from the University?	
15.	Did the Institution & Department produce any Ph.D. during the academic years? (Numbers may be given)	
16.	Does the Institution & Department have any running minor research project? (Numbers and total amount may be given)	
17.	Does the Institution & Department have any ongoing major / minor research project now? (Numbers and total amount received may be given)	
18.	Did the Institution & Department receive any financial assistance from agencies like DST, SERB, DST-FIST, UGC-SAP, DBT-Star Schemes, ICSSR, UGC, ICMR, DBT (special	

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	schemes, other than projects and development assistance), etc. during the academic year?	
19.	Did the Institution & Department conduct seminars / workshops / conferences, etc. during the academic year?	
20.	Did the Institution & Department sign any MoU with industry or any other agency?	
21.	Does the Institution & Department conduct consultancy services?	
22.	Does the department conduct student counselling?	
23.	Does the Institution & Department arrange placement for students?	
24.	Does the Institution & Department conduct/coordinate any kind of extension activities?	
25.	Does the Institution & Department participate in interdepartmental cultural contests?	
26.	Mention the association activities if any, during the academic year	
27.	Mention the performance in the sports activities during the academic year	
28.	Students Senate / Union, Grievances redressal Committee, Welfare Committee, Counselling Centre, Ethics Committee, Anti-ragging squad and committee	
29.	Are any members of the department involved in the administrative activities / club / Forum / Chapter / Professional bodies / committees of the University / College?	
30.	Functioning of Alumni Association, Parents and Teachers Association, Staff & Student's Welfare Committee in the Campus	
31.	Display of Laboratory Instruction Chart and availability of Laboratory manual and stock for equipment, chemicals and glassware and plasticware items in each Laboratory	

IV. Green / Energy / Environment / Hygiene / Soil & Water / Waste Management Audits		
S.No	**Description of Records / Documents**	**Remarks**
1.	Have internal Environment / Green / Energy / Hygiene / Soil & Water / Waste management audit procedures been developed and implemented in the Organization?	
2.	Have programmes for the achievement of environmental objectives and targets been established and implemented as on today?	

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