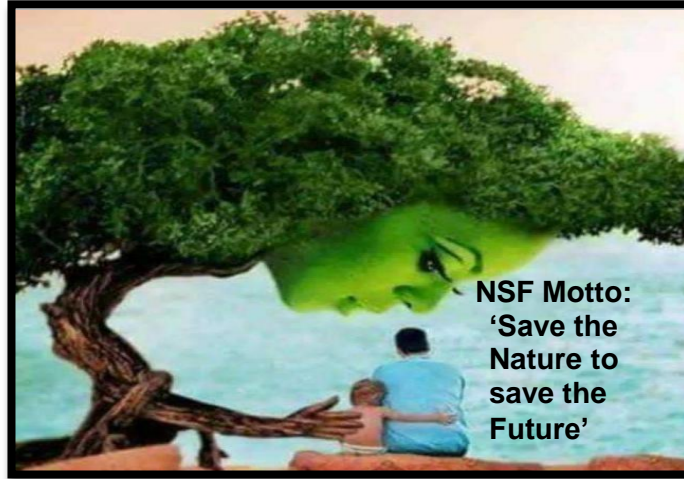


# TECHNICAL REPORT OF GREEN CAMPUS AUDIT



*Submitted to*

**ADICHUNCHANAGIRI INSTITUTE OF  
TECHNOLOGY, CHIKKAMAGALURU – 577 102,  
KARNATAKA.**

*Date of Audit: 22.06.2022*

*Submitted by*



## **NATURE SCIENCE FOUNDATION**

*(A Unique Research and Development Centre for Society Improvement)  
[ISO QMS (9001:2015), EMS (14001:2015), OHSMS (45001:2018) &  
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## 1. Introduction

Green campus is an area of the Organisation or the Organisation as a whole itself contributing to have an infrastructure or development that is structured/planned to incur less energy, less water, less or no CO<sub>2</sub> emission and less or pollution free environment (Aparajita, 1995). Green Campus Audit is a tool to evaluate environment management system which is systematically executed to protect and preserve the environment. Green campus audit constitutes the environmental friendly practices and education combined to promote sustenance of green environment adopting user-friendly technology within the campus. It creates awareness on environmental ethics, resolves environmental issues and offers solutions to various social and economic needs (APHA, 2017). It strengthen the concept of “Green building” and “Oxygenated building” which in turn provides a healthy atmosphere to the stakeholders.

Green Campus Audit ensures the Organization’s campus should be greenish with large diversity of trees, herbs, shrubs, climbers and lawns to reduce the environmental pollution and soil erosion; it is also useful in relation to biodiversity conservation, landscape management, irrigation/economic water utilisation and maintenance of natural topography and vegetation (Gowri and Harikrishnan, 2014, Aruninta *et al.*, 2017). The maintenance of an eco-friendly campus ensures a neat and clean environment. For the benefit of stakeholders, solid waste management, recycling of water, disposal of sewage and waste materials (electronic and biomedical wastes), ‘zero’ use of plastics, etc. should be followed consistently in the organization campus.

Green Campus Audit procedures includes the definition of green audit, methodology on how to conduct Green audit at Educational Institutions and Industrial sectors as per the checklist of Environment Management Systems and International Standards on ISO 14001:2015, Indian Green Building Council, Swachh Bharath Scheme under Clean India Mission to understand the principles and importance of various audits in the context of the organization and risk assessment at 360° views. Green campus audit helps the educational institutions/ industries to maintain eco-friendly environment, assures personal hygiene to various stakeholders and supports the nation; on the whole for the noble cause of environmental protection and nature conservation which in turn enhances the quality of life of all living beings (Arora, 2017).

## 2. Role of Educational Institutions in India

Educational institutions are playing important role in a nation’s growth and development which starts from maintenance of green campus without harming the environment. A clean and healthy environment in an Organization determine effective learning skills and offers a conducive learning environment to the students. Educational institutions are insisted by both Central and State Governments to offer eco-friendly atmosphere to the stakeholders. In addition, all the Educational institutions are asked to save the environment for future generations and to resolve the environmental problems (accumulating solid wastes and wastewaters/effluents and their careless disposal, enormous utility of plastics, uneconomical consumption of water, irresponsible in water harvesting and storage procedures, etc.) through Environmental Education. Implementing Swachh Bharath Abhiyan Scheme launched by the Indian Government thro’ the Educational institutions plays a major role in terms of giving neat and clean

environment to tribal, rural and urban people across the country, besides the regular and conventional activities carried out by NSS, NCC/Student Force, Nature club, Eco club, Science club, Fine Arts club, Flora and Fauna club, Youth Red cross unit, etc. Seminar, Conference, Workshop, training and awareness programmes on Biodiversity conservation education, environmental awareness programmes, etc. may be conducted periodically by the Management and Administrative people of an Organization to the stakeholders.

Green campus auditing is a systematic method whereby an organization's environmental performance is checked against its environmental strategies and compliances of the Government guidelines. This audit process is definitely useful for the Educational institutions to maintain the campus neatly and can give pure atmosphere to the students and staff members including Management people. It is like an official examination of the environmental effects on an organization's campus as per the Government guidelines. The audit report may be useful to improve the organization's campus significantly by following the recommendations and suggestions given in the report. The green campus audit processes are being undertaken by World / Indian Green Building Council (IGBC), Green Building Code and Green Ratings Systems (GBCRS), Green Rating for Integrated Habitat Assessment (GRIHA), Consideration of Indian Industry GreenCo Rating System (CII-GreenCo) and Associated Chambers of Commerce and Industry of India (ASSOCHAM) along with ISO EMS 14001:2015 criteria and the concept of Swachh Bharath Abhiyan under Clean India Mission

### **3. Green Campus and Environment Policy**

Green campus and environment policy aims to provide an education and awareness in a clean and green environment to the stakeholders with regard to environmental compliance. Scope of the policy applies to all employees and students of the Institution/organisation to provide an ecofriendly atmosphere. Green Campus Policy dealt with cleanliness of the campus maintained through proper disposal of wastes and steps to be followed to recycle the biodegradable wastes and utilization of eco-friendly supplies to maintain the campus free from hazardous wastes/pollutants. The concept of eco-friendly culture is disseminated among the students as well as rural community through various awareness programmes. Attempts are made to minimise the energy usage and substitute the non-renewable energy sources with renewable energy sources. Head of the Organization, Departmental Heads and Senior Managers/ Management Representatives are responsible for monitoring the "Go Green" initiatives of the College/University and maintain a clean/green campus while each and every individual of the organisation should adhere to the policy.

### **4. Environment Friendly Campus**

As stated earlier, Organization is liable to provide an eco-friendly atmosphere along with good drinking water facility to all the stakeholders (students and staff members). Manuring the cultivated plants/grown within the campus may applied with organic manure, cow dung, farmyard manure and vermicompost instead of using chemical fertilizers. All non-compostable and single-use disposable plastic items, plastic utensils, plastic straws and stirrers should be avoided. Demonstration/awareness programme on establishing plastic-free environment and utility of organic alternatives for all incoming and current students, staff and faculty should be organised. Reduction

of use of papers alternated with e-services, e-circulars, etc. and proper disposal of wastes, recycling and suitable waste management system should be considered to establish environment friendly campus.

### **5. Aims and Objectives of Green Campus Audit**

- To recognise the initiatives taken towards establishing the green campus in terms of gardening.
- To grow a large number of oxygens releasing and carbon dioxide assimilating plants in the campus to give a pure atmosphere to the stakeholders.
- To identify and provide baseline information to assess threat and risk to the ecosystem due to Organization development.
- To recognise and resolve different environmental threats of the Organization.
- To ensure proper utilization of resources available in the surrounding areas towards future prosperity of the humanity.
- To fix a couple of norms for disposal of all varieties of wastes and use green cover as a carbon sink for pollution free air.
- To assess the greenish nature of an Organization campus in terms of trees, herbs, shrubs, climbers, twins, lianas, lawns and reflected in reducing the environmental pollution soil erosion, biodiversity conservation, landscape management, natural topography and vegetation.

### **6. Importance of Green Auditing**

The Management of the Organization (Auditee) should be exposed their inherent commitment towards making ecofriendly atmosphere through the green auditing and ready to encourage/follow all types of green activities. They should promote all kinds of green activities such as conduct of environment awareness programmes, in-campus farming, planting trees and maintenance of greening, irrigation, use of biofertilizers and avoidance of chemical fertilizers and agrochemicals, etc., prior to and after the green campus auditing (Suwartha and Sari, 2013). The administrative authorities should formulate 'Green and Environment Policies' based on technical report of green campus auditing. A clean and healthy environment will enhance an effective teaching/learning process and creates a favorable learning green environment to the scholars. They should create the awareness on the importance of greenish initiatives through environmental education among the student members and research scholars. Green Audit is the most effective, ecological approach to manage environmental complications.

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 huge number of trees which is a duty of each and every individual who are the part of economical, financial, social, and 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 beneficial effects in order to save planet by means of 'Go green concept' which in turn support the institution to set environmental models ('icon') for the community. Green audit is a professional and useful measure for an Organization to determine how and where they are retaining the campus eco-friendly manner. It can

also be used to implement the alleviation measures at win-win situation for the stakeholders and the planet. It provides an opportunity to the stakeholders for the development of ownership, personal and social responsibility.

## **7. 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 based on the audit report. 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 of 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 in accordance with prevailing rules issued by the government/local authorities
- Assigning the roles and responsibilities to the Environmental Engineer and Agriculture Staff who are all responsible 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
- 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 releasing and carbon dioxide assimilating plants planted in the campus to give pure atmosphere to the stakeholders.
- Operation of water irrigation, drip and sprinkler irrigation methods to improve the green 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/Student Force 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.
- High degree of resource management offers the basis for improved sustainable and creation of plastic free campus to evolve health consciousness among the stakeholders.
- Impart of knowledge on environment through systematic management approach and improving environmentally friendly standards by creating 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.

## **8. About the Organization**

### **8.1. Adichunchanagiri Institute of Technology,**

Adichunchanagiri Institute of Technology (AIT) was established in the year 1980 at Chikkamagalur (240 km from Bangalore), with the blessings of revered Jagadguru Padmabhushana Sri Sri Sri Dr. Balagangadharanatha Maha Swamiji, pontiff, of Sri Adichunchanagiri Maha Samsthana Math. Chikkamagalur city is 20 km from the world-famous sculpture Belur Temple. The Adichunchanagiri Institute of Technology is affiliated to Visvesvaraya Technological University, Belagavi and Recognized by All India Council for Technical Education, New Delhi. The Institute is Accredited by the National Assessment and Accreditation Council (NAAC) with B+ grade. Institute is Accredited twice by National Board of Accreditation (NBA) and also an ISO 9001:2008 Certified Institution.

The renowned temple of Sringeri Sharadamba and Sri Shankaracharya Mutt is just 100 km away. Spread out over 65 acres of land with green surroundings and picturesque hillocks, the college has a conducive atmosphere for education. The weather is salubrious and pleasant throughout the year. The vision of the Institute is to develop as a center of excellence and to strive for continuous improvement of technical education and human resource advancement and the mission is to achieve 13 Excellence in Education, Entrepreneurship and Innovation by producing Engineers with high Ethical Standard, Integrity and Credibility.

The Institute has highly qualified and experienced faculty with a reputation in their areas of specialization, well-equipped laboratories, seminar halls with projectors, sufficient books and periodicals in the library, hygienic canteen facility with hostels for both girls and boys, a huge amphitheater for cultural exposure and fleet of buses for transportation. The Institute is providing good training for students to excel in academics as well as in industry requirements and aiming towards 100% placements to give a better future for students. The main objectives of AIT are

- To create sustainable teaching - learning process in all academic units that promote pedagogical innovations.
- To transform students by facilitating holistic personality development and sustenance of talent.
- To nurture higher commitment towards learning, research and creative thinking among students and faculty members.
- To enhance industry-institute relationship to accelerate students' industry readiness.

The vision is to foster AIT as a centre for nurturing and developing world class Engineers and Managers who convert global challenges into opportunities through value-based quality education. The mission is to impart value-based quality education through effective teaching and learning processes. To nurture creativity, excellence, and critical thinking by applying global competency factors to contribute and excel in the rapidly growing technological world. To continuously develop and improve holistic and innovative personality for global mobility. To make AIT a centre for excellence.



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

NSF is an ISO QMS (9001:2015), EMS (14001:2015), OHSMS (45001:2018) & EnMS (50001:2018) Certified and registered with Ministry of Micro, Small and Medium Enterprise (MSME), Government of India Organization functioning energetically towards the noble cause of nature conservation and environmental protection. NSF is managed by a board of trustees of NSF Public Charitable Trust under the TN Societies registration Act 1975 (TN Act 27 of 1975) on 29<sup>th</sup> November, 2017 at Peelamedu, Coimbatore - 641 004, Tamil Nadu, India with Certificate of Registration No. 114 / 2017. In addition, NSF has 12AA, 80G and Form 10AC certificates for income tax exemption and implanting various Government schemes. The main motto of the NSF is to “Save the Nature to Save the Future” and “Go Green to Save the Planet”. NSF Branch Offices are also functioning effectively at Gorakhpur, Uttar Pradesh and Faridabad, Haryana, India to adopt the ‘Go Green Concept’ in a big way. NSF family is wide spread across India with over 115 state-wise Lead auditors to conduct Green and Environment Audits.

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

International Eco Club Student Chapter (IECSC) has been established for Student volunteers and faculty members are encouraged to conduct National and International events, Student Technical Symposium, Distinguished lecture programme, Environment day celebration, Ozone day celebration, Project model exhibition, Awareness programmes on Environmental pollution, Biodiversity and Natural resources conservation and etc. with the financial support of the Foundation. NSF is being released ‘Magazine’ and ‘Newsletter’ biannually to share the information about Environmental awareness programmes on biodiversity conservation, seminar on soil conservation, water management and solid waste management, restoration and afforestation programmes in Western Ghats of southern India.

In order to encourage the students, members of faculty, academicians, scientists, entrepreneurs and industrial experts those who are involving in nature protection and biodiversity conservation studies across the world, NSF tributes the deserved meritorious candidates with various awards and honours such as ‘Best Faculty Award’, ‘Best Women Faculty’, ‘Best Scientist Award’, ‘Best Student Award’, ‘Best Research Scholar Award’, ‘Best Social Worker Award’, ‘Young Scientist Award’, ‘Life-Time Achievement Award’ and ‘Fellow of NSF’. These award and honours will be given to the deserved meritorious candidates during the ‘Annual Meet and Award Distribution Ceremony’ which will be conducted every year during the first week of January.

NSF has introduced various types of Audits such as ‘Eco Audit’, ‘Green Audit’, ‘Energy Audit’, ‘Hygienic Audit’ Water & Soil Audit, Plastic Waste Management Audit, Biomedical Waste Audit, Solid Waste Management Audit, E-Waste Management Audit, Academic & Administrative Audits including ISO certification process to Academic Institutions, R&D Organizations and Industries towards the accreditation process as well as maintaining a hygienic eco-friendly environment to the stakeholders in their campus. All audits will be

conducted as per the Checklist prepared by the NSF ISO Criteria and in compliance with Government Law and Environmental Legislations including World / Indian Green Building Council and the concept of Swachh Bharath Abhiyan under Clean India Mission. Green campus and Environment Policy, Purchase Policy, Energy Policy, MoU, International Eco Club student Chapter.

**Table 1. The AIT Campus facility details**

<b>S.No.</b>	<b>Details of Area</b>	<b>Total area</b>
1.	Total Campus area	2,16,140 sq.mt
2.	Total Built up area	36,000 sq.mt
3.	Covered Car parking area	33500 sq. ft
4.	Forest vegetation	45%
5.	Planted vegetation	55%

## 9. Audit Details

<b>Date / Day of Audit</b>	<b>: 22.06.2022</b>
<b>Venue of Audit</b>	<b>: Adichunchanagiri Institute of Technology, Chikkamagaluru</b>
<b>Audited by</b>	<b>: Nature Science Foundation, Coimbatore, Tamil Nadu, India.</b>
<b>Audit type</b>	<b>: Green Campus Audit</b>
<b>Name of Auditing Chairman</b>	<b>: Mrs. S. Rajalakshmi Jayaseelan, Chairman of NSF &amp; ISO QMS, EMS, OHSMS, EnMS Auditor.</b>
<b>Name of IGBC AP Auditor</b>	<b>: Dr. B. Mythili Gnanamangai, Vice Chairman of NSF &amp; Indian Green Building Council Accredited Professional.</b>
<b>Name of Lead Green Auditor</b>	<b>: Dr. R. Mary Josephine, Plant Taxonomist &amp; Principal, St Joseph College for Women, Tiruppur, TN.</b>
<b>Name of Subject Expert-I</b>	<b>: Dr. D. Vinoth Kumar Joint Director of NSF &amp; ISO EnMS Auditor.</b>
<b>Name of Subject Expert-II</b>	<b>: Mr. B.S.C. Naveen Kumar, Senior Faculty, Mahatma Gandhi National Council of Rural Education, Ministry of Higher Education, Hyderabad.</b>
<b>Name of Subject Expert-III</b>	<b>: Er. D. Dinesh Kumar, Certified Lead Auditor, IGBC, ASSOCEM, GRIHA &amp; LEED</b>
<b>Name of the Energy Auditor</b>	<b>: Dr. N. Balasubramanian, Certified Bureau of Energy Efficiency Auditor of NSF.</b>
<b>Name of Eco &amp; Green Officer</b>	<b>: Ms. R.S. Thulaja, Environment, Energy &amp; Green Council Programme Officer, NSF.</b>

## 10. Procedures followed in Green Campus Audit

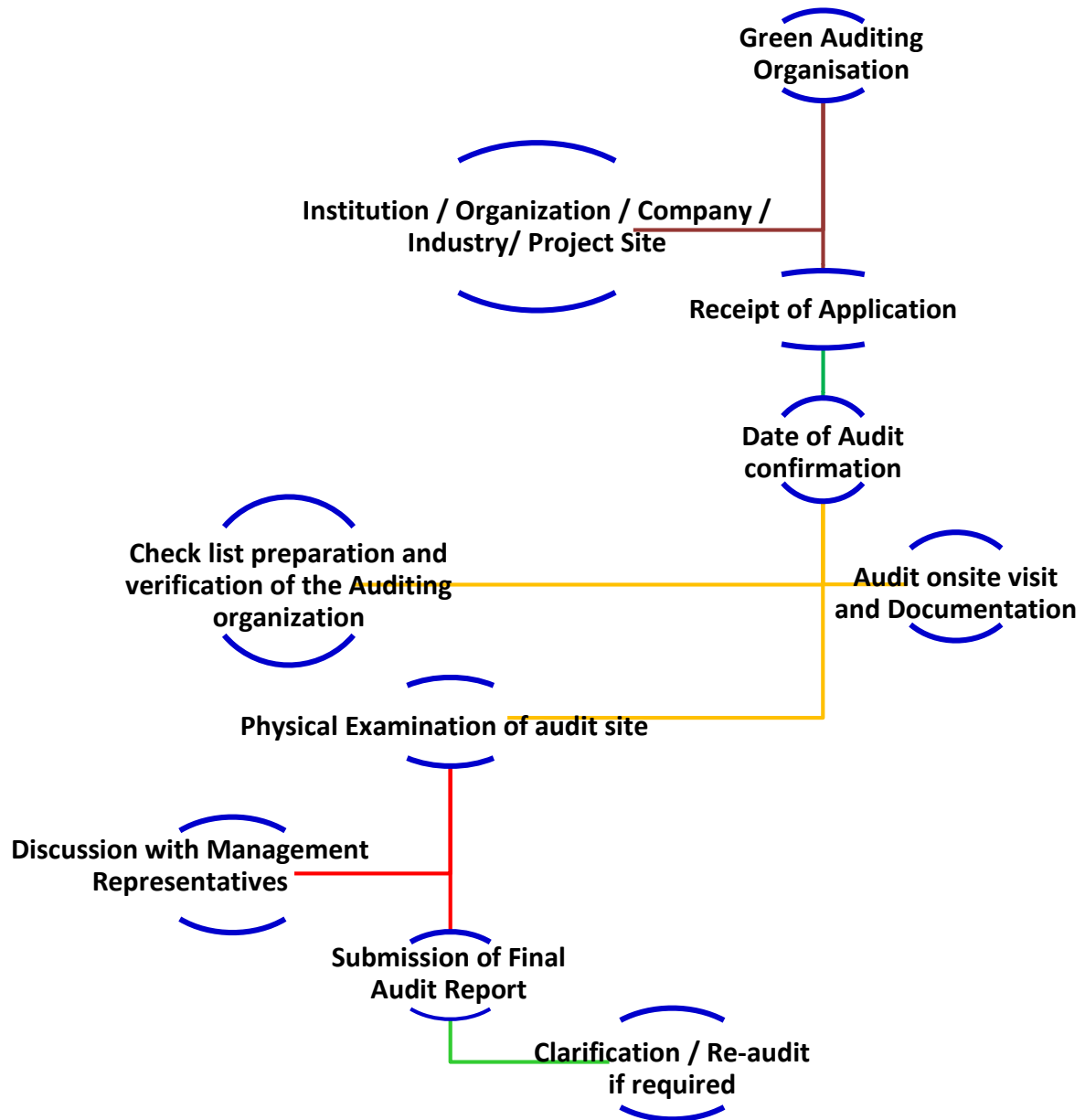
Green campus audit is a structured process of documenting the credentials in terms of number of trees, herbs, shrubs, lawns, climbers and lianas reflected in reducing the environmental pollution and soil erosion and useful for biodiversity conservation, landscape management, natural topography and vegetation. 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. First step of the audit is ensuring that the organization has a central role in building the green campus, in order to validate the same (Adeniji, 2018). 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](http://www.nsfonline.org.in)) through the authenticated Professionals for people qualified to investigate and evaluate the campus for validating the best environmental practices (Staniskis and Katiliute, 2016, SCSR, 2018). 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.

During the audit, the nature of plants and animals / bird's species thriving within 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, drip and sprinkler irrigation methods and use of recycled water for irrigation purpose or any other purpose in the campus area were noted.

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 (Lauder *et al.*, 2015; Brindusa *et al.*, 2007). 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 (Leal Filho *et al.*, 2015). During the audit

process, the best environmental / greenery practices followed and new initiatives undertaken in the organization to reduce the environmental pollution and steps taken for nature conservation that brings added value to the organization in maintaining the eco-friendly campus were assessed. In addition, supporting activities of the scholars and staff with regard to “Vision and Mission” of the greenery activities of the Organization is also evaluated.



**Flow-chart of Green Campus Audit Procedures**

### 10.1. Onsite Green Campus Audit activities

1. Opening meeting is the first step between the audit team and auditee along the Management Representatives where the purpose of the audit, procedures to be adopted for the conduct of the audit, verification of the documents and the time schedules were discussed, in brief.
2. Followed by opening meeting, onsite inspection will be conducted which is the second step in the audit where the Audit team members visited different sites in the AIT campus and required 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 AIT 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. The assessment reveals the strengths and weaknesses of the Auditee's Management controls and risks associated with their failure in creating Green campus facilities.
5. Collecting audit proofs *ie*, data collection and information from the auditee as per the audit protocol were carried out.
6. An exit meeting was conducted to describe the findings of the audit with Management Representatives and staff members along with the audit team in brief.

### 10.2. 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 a chance to emphasize the scope and objectives of the audit and discussions held on the feasibilities associated with the audit (Marrone *et al.*, 2018). Pre-audit stage activities are an essential prerequisite for the green audit to meet the auditee and to gather information about the campus and required documents were collected directly from the Organization before the start of the audit processes (Fachrudin *et al.*, 2019). Audit team was selected by the Nature Science Foundation as per the checklist comprised of Lead Auditor of ISO (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.



**Auditing Team of the Nature Science Foundation, Coimbatore, Tamil Nadu at Adichunchanagiri Institute of Technology, Chikkamagaluru, Karnataka**

### Energy and Environment audit activity at the AIT by the NSF Audit Team



### 10.3. 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 concentrate on the efficient use of energy and water; minimize waste generation or pollution and also improve the economic efficiency. Green campus audit process may be undertaken at frequent intervals and their results can demonstrate 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 (Choy and Karudan, 2016).

There are several targets 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 releasing and carbon dioxide assimilating plants, landscape management, topology, vegetation, soil erosion control, carbon footprint due to use of vehicles, electricity and fossil fuels (León-Fernández and Domínguez-Vilches, 2015). 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, persons needs special attention and or maternity care, security, safety and health infrastructure facilities for stakeholder's wellbeing (Nunes *et al.*, 2018).

### 10.4. Flora and Fauna diversity of study area

The AIT Campus is situated in Chikkamagaluru, Karnataka, India. It is located about 17.2 km from B G Nagar railway station. At present, the campus is quite clean, green and with much less pollution when compared to the rest of the city. Study/documentation of 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 natural flora and fauna conservation.

#### 10.4.1. Topography

The AIT consists of an environment of Tropical and deciduous type with a mixture of teak, located at a minimum elevation of 955 m above mean sea level and maximum elevation of 1090 m above mean sea level. The district is between 12° 54' 42'' and 13° 53' 53'' North latitude and between 75° 04' 46'' and 76° 21' 50'' east longitude.

#### 10.4.2. Geology and Soil condition

The geology of AIT comprises hard rocks of granite and Black soil.

#### 10.4.3. Climatic conditions

Considering climate condition, Chikkamagaluru generally has a moderate to cool climate. The temperature of the city varies from 11-20 °C during winter to 25-32 °C during summer. The average normal rainfall is 53.32 cm annum The driest month is January, with 7 mm | 0.3 inches of rain. Most precipitation falls in July, with an average of 320 mm | 12.6 inch.

**Table 2. Soil edaphic and environmental parameters of the AIT**

S.No	Details of Parameters	Data collected
<b>Soil edaphic parameters</b>		
1.	Soil pH	6.43
2.	Soil types	Black soil, red soil, Gravel soil.
3.	Total organic carbon	4.5%
4.	Electrical conductivity	0.11 dSm <sup>-1</sup>
5.	Water holding capacity	80%
6.	Total Nitrogen	4.0 ppm
7.	Available Phosphorous	6.0 ppm
8.	Exchangeable Potassium	3 ppm
<b>Environmental parameters</b>		
1.	Minimum Temperature	14°C
2.	Maximum Temperature	31°C
3.	Minimum Relative humidity	45%
4.	Maximum Relative humidity	79%
5.	Annual Average Rainfall	2075 mm
6.	Annual Average Sunshine	6 hrs/avg.day
7.	Wind speed	3 k/hr.

## 11. Identification of Plant Species

### 11.1. Identification of Flowering Plant Species

Various vascular plant species were collected across the AIT campus and subjected to botanical identification (botanical name, family, habitat, and economic importance) and anthropogenic disturbances to the natural vegetation in campus. Plants were freshly collected and their digital photographs were also taken. The collected plant specimens have been identified using taxonomic literatures (Gamble and Fischer, 1972; Matthew, 1983; Nair and Henry, 1983; Henry *et al.*, 1989; Chandrabose and Nair, 1988). Further, their identification was confirmed by matching with authentic specimens in the Madras Herbarium (MH), Botanical Survey of India (BSI), Southern Circle, Coimbatore, Tamil Nadu, India.

### 11.2. Identification of Non-Flowering Plant Species

#### 11.2.1. Lichen Identification

Lichen specimens were collected from the AIT campus and then identified based on the lichen identification key of Awasthi (2007). Representative lichen specimens were identified based on thalli morphology such as rhizine, cilia and pseudocephellae and reproductive structures (fruiting bodies) such as apothecia, perithecia, soredia, soralia, conidia and isidia embedding on the thalli surface using a stereo microscope (CZM4, Labomed, India). In the present study, Anatomy of the thallus were carried out in order to document micro morphological features such as medulla thickness, upper and lower surface of thallus, lobes, size and shape of spores. Thin section of apothecia and perithecia was made to observe the nature ascus spores and the arrangement of the algal and fungal layers in the thallus; respectively. Spot tests featured the use of chemical reagents to detect lichen substances by appearances of the characterized colour changes on lichen thallus was noted. The lichen chemistry was analyzed according to Culberson and Kristinson (1970) methods. The colour spot test was done



on medulla of lichen thallus using test reagents of potassium hydroxide (K), calcium hypochlorite (C) and paraphenylene di amine (PD). Lichen was identified based on colour spot test using the procedure defined by Orange *et al.* (2001).

To authenticate the identified lichen samples, the representative samples were compared with the voucher specimens at the Lichen Herbarium Centre of National Botanical Research Institute (NBRI), Lucknow, Uttar Pradesh, India and Department of Botany, Bharathiar University, Coimbatore, Tamil Nadu. The lichen species might be confused with other species unless their morphological, biochemical and anatomical features were closely monitored. Therefore, apart from microscopic observation, spot tests, chemical profiling and TLC tests, attempts were made to compare the representative samples with voucher specimens.

### **11.2.3. Identification of Algae Genera**

Algae are the members of a group of predominantly aquatic photosynthetic organisms of the kingdom *Protista* followed by terrestrial algae found in freshwater and slump areas. Algae are non-flowering and lower group of plants which are green in colour because of presence of chlorophyll pigments in the body called thallus. Algae adopt diverse life cycles, and by size, they range from microscopic *Micromonas* to giant kelps that reach 60 metres (200 feet) in length. Their photosynthetic pigments highly varied when compared to that of higher plants; their cells have features not found among plants and animals. In addition to their ecological roles as oxygen producers, they serve as food base for almost all aquatic life; algae are economically important as a source of crude oil and as sources of food and a number of pharmaceutical and industrial products for humans. Algae are defined as eukaryotic (nucleus-bearing) organisms that photosynthesize. They lack specialized multicellular reproductive structures of plants, but they always contain fertile gamete-generating cells surrounded by sterile cells. Algae also lack true roots, stems, and leaves features they share with the avascular lower plants (e.g., mosses, liverworts, and hornworts). Algae identification key consists of couplets of characteristics using algal description of the specimen based on morphological characterization from 58 Genera to species level identification as per the comprehensive key.

## **12. Identification of Mammals, Birds, Reptiles, Amphibians and Termites**

Birds were observed by visual sightings and by calls also the avifaunal data were observed through the Nikon 8 x 40 binoculars and photographs were taken by Canon 600 D camera (55 – 250 mm). The recorded data was noted in the field work note. Later, the birds were identified with the help of field guide- "Birds of Indian subcontinent" by Richard Grimmett, and the IUCN category of the birds were also noted with the same. The point count and transect line methods were used to record the number of bird species in the study area in which regular visits and personal visits were carried out (Ferenc *et al.*, 2014). The surveys were conducted to understand the distribution of bird species in relation to habitats and nesting behaviour of birds in the study area. Based on survey richness and abundance of bird species were calculated using Shannon-weaver diversity index. Based on available data and species were selected for nest site selection study. Selected species of birds was analysed for its nest site characteristics between the habitats and also plant species preference was enumerated and assessed. The number of

breeding bird species and nests found in different habitats as depend variables such as biotic and biotic factors as the independent variable (Jayson and Mathew, 2000).

Reptiles and Amphibians are identified based on colouration, markings on the skin, background colour generally brown, Males often have a flecked pattern on back. Occasionally they are in green, leading to mistaken identification as sand lizard, Males have thicker base to tail and brighter, speckled underside. Newborn young are dark in colour, almost black. A rare species, almost entirely confined to heathland sites in Dorset, Hampshire and Surrey, and sand dunes on the Mersey and Welsh Coast. The most common reptile found in a variety of habitats, including gardens. Spends most of its time underground or in vegetation litter. Most likely to be found underneath objects lying on the ground, or in compost heaps. Snakes are identified based on cream, yellow or white collar behind the head, bordered to the rear by black marks. Body colour ranges from bright green to dark olive, but mostly the latter. Darker specimens can appear black from a distance. Truly black grass snakes are rare. Males are predominately brown, females are grey. Dark butterfly shape on top of head may be noted. Pairs of spots, sometimes fused as bars, running along back with black line running through eyeare recorded. Males typically grey with a black zigzag stripe, females generally brownwith a dark brown zigzag stripe (Beebee and Griffiths, 2000).

### **13. Green Campus Audit Observations**

It covers both qualitative and quantitative measurements including physical observation of greeneries in terms of growing of terrestrial and aquatic plants, animals and microflora in natural and planted vegetation and their maintenance. Topography, landscape management design and soil erosion control are playing important role in environment sustainable development in the campus. An account of a large number of Oxygen releasing and Carbon dioxide assimilating plants planted in the Campus are taken into consideration to give pure atmosphere to the stakeholders. Establishment of different types of gardens in the campus, rainwater harvesting system, operation of water irrigation, drip and sprinkler irrigation methods may be adopted to improve the green campus. Similarly, biodiversity conservation strategies are very essential to conserve a variety of plant and animal species in the campus ecosystem. Biofertilizers, organic and green manures, cow dung manures and farmyard manures may be used for the cultivation of plants which may be protected the environmental health that will not cause any air, water and soil pollution. The various Clubs, Forums, Cells, Associations and Student / Staff Chapters such as Eco club, Nature club, Science club, Fine Arts club, Flora and Fauna club, Youth Red Cross, NCC/Student Force and NSS bodies maybe involved in green campus initiatives, planning and efforts among stakeholders. Outreach programmes may be conducted for dissemination of Green Campus motto and Green pledge initiatives to rural, tribal and urban people. Academic credentials like taking up major and minor Projects, Dissertations and Thesis work by the students and staff members may be taken into account towards green campus initiatives, planning and efforts. Best practices followed on green campus initiatives in the Organization and recommendations for greening are illustrated in the audit report as well.

**Table 3. Qualitative Measurements of Green Auditing**

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	✓		
	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 calculated (45L/P/C/D)	✓			
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/Student Force, 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 towards environment monitoring	✓		
20.	Observation on the site preservation, soil erosion control and landscape management	✓		
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	✓		

**Table 4. Quantitative Measurements of Green Auditing**

S.No.	Details of Plant and animal species	Numbers / Percentage
1.	Total number of Flowering plant species inside the Campus	123 species belonging to 72 Genera, 52 Families.
2.	Total number of Non-Flowering plant species inside the Campus	75
3.	Total number of living Mammals inside the Campus	NIL
4.	Total number of visiting Mammals inside the Campus	3 species belongings Squirrel, Shrew and Mouse
5.	Total number of living Birds inside the Campus	20 species belonging Stork, Heron, Pigeon, Myna, Robin, Sparrow, Dove and owl.
6.	Total number of visiting Birds inside the Campus	5 species belonging Cormorant, Kingfisher, bee-eater, Bulbul and Drongo.
7.	Total number of Aquarium	Percolation Pond 2, Openwell water Facility -2
8.	Total number of Aquatic (hydrophytes) plant species	Two species belonging to <i>Lotus and Water Hyacinth</i> ,
9.	Total number of Grasshopper and Termites	Grasshopper: 6 species Termites: 4 species
10.	Total number of Amphibians and Reptiles	Amphibians: 8 species Reptiles: 6 species
11.	Total number of Butterflies and Mosquitos	Butterflies: 13 species Mosquitos: 03 species
12.	Percentage of Forest Vegetation	45 %
13.	Percentage of Planted Vegetation	12.5%
14.	Percentage of Water consumption to total human population	2.78%
15.	Percentage of Water consumption to total flora and fauna	11.7%
16.	Per capita water consumption per day	67.8%

### 13.3. Flora and Fauna diversity in the AIT Campus

#### 13.3.1. Flora diversity in the AIT Campus

##### 13.3.1.1. Flowering plants diversity in the AIT Campus

Ensuring the rich biodiversity in the green campus is an important parameter which reflects the real-time ecosystem. 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 dioxide. The green and varying colour of the flowering plants improve the ambience of the Organization environment. The record on maintenance of the plant biomass and its management are important with respect to green campus initiatives. The existence of such plants and birds in the green campus may be recorded for the rich flora and fauna which are being considered as a value addition to the campus.

The observations indicated that the AIT campus has more than 80 % of wild as well as native plant species and the other 25% plant species are ornamental in nature coming under the planted vegetation. Native plant traits promote the indigenous fauna at the site area. Hence, the accountancy of 40 % of the wild traits are leveraged for the native animals and birds. The most probable natural vegetation of AIT campus is the dry deciduous type. The remnants of this past vegetation are found in the campus.

The most plants recorded are *Roystonea regia*, *Araucaria columnaris*, *Azadirachta indica*, *Araucaria heterophylla*, *Bauhinia variegata*, *Callistemon lanceolatus*, *Bambusa vulgaris*, *Cassia fistula*, *Cocos nucifera*, *Delonix regia*, *Mangifera indica*, *Dyopsis lutescens*, *Michelia champaca*, *Polyalthia longifolia*, and *Terminalia arjuna* which are dominant trees species characteristic to the vegetation within the campus. Some of the shrub species like *Abutilon indicum*, *Caesalpinia pulcherrima*, *Canna indica*, *Hamelia patens*, *Hibiscus rosa-sinensis*, *Microcos panicula* and *Plumeria obtusa* are also rather common in the campus.

Ground flora is comparatively sparse, but fairly rich in undistributed areas. Some of the common weeds like *Achyranthes aspera* and *Alternanthera sessilis* are found to be predominant. Species such as *Aristida pinnata*, *Asystasia gangetica*, *Bidens pilosa*, *Chenopodium album* sp., *Evolvulus alsinoides*, *Oldenlandia corymbosa*, *Parietaria officinalis* and *Turnera subulata* are some common herbs in the campus.

Certain common climbers found among the shrubs are *Allamanda cathartica*, *Clitoria ternatea*, *Combretum indicum*, *Epipremnum aureum*, *Passiflora incarnata*, *Pyrostegia venusta*, *Thunbergia grandiflora* and *Tribulus cistoides*. This campus is rich in grass species like *Dactyloctenium aegyptium*, *Chloris barbata* and *Cynodon dactylon*.

Most of the species found are common in the campus, some of the species *Cucumis dipsaceus* Ehrenb, *Bothriochloa compressa* (Hook.F.), *Chloris bournei* Rang & Tadul. are rare species. Some endemic grass species like *Andropogon pumilus* Roxb., *Caralluma bicolor* Ramach., *Panicum psilopodium* Trin., and *Perotis indica* (L.) Kuntze are also occurring in the campus. Number of above species decreased in number and a few face the danger of going extinct due to anthropogenic activities (regular clearing and construction activities). Hence in terms of conserving the available floral biodiversity, it is pertinent to set up a botanical garden within the campus and cultivate

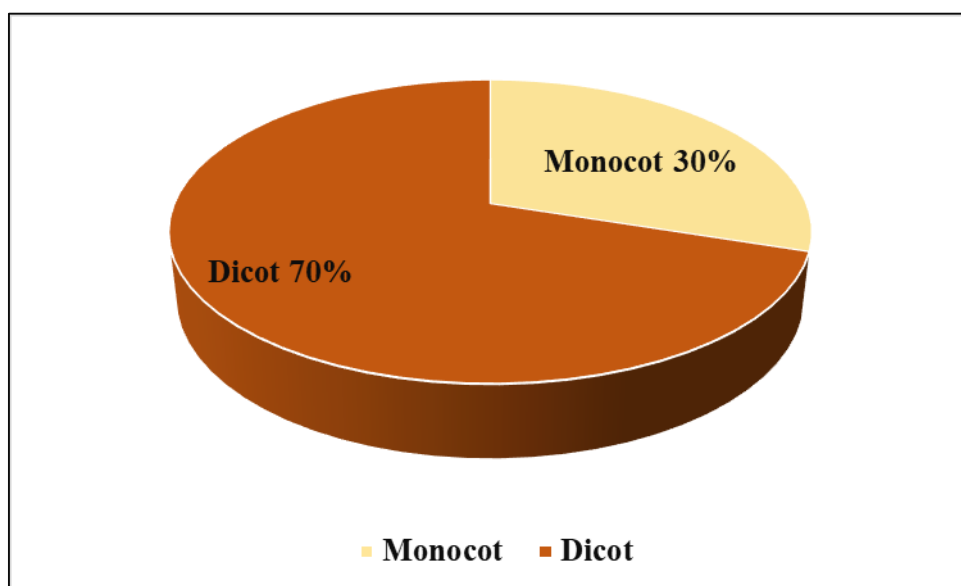
them while protect the ones that grownaturally on the grounds upon the vegetation maintenance.

### **Invasive species**

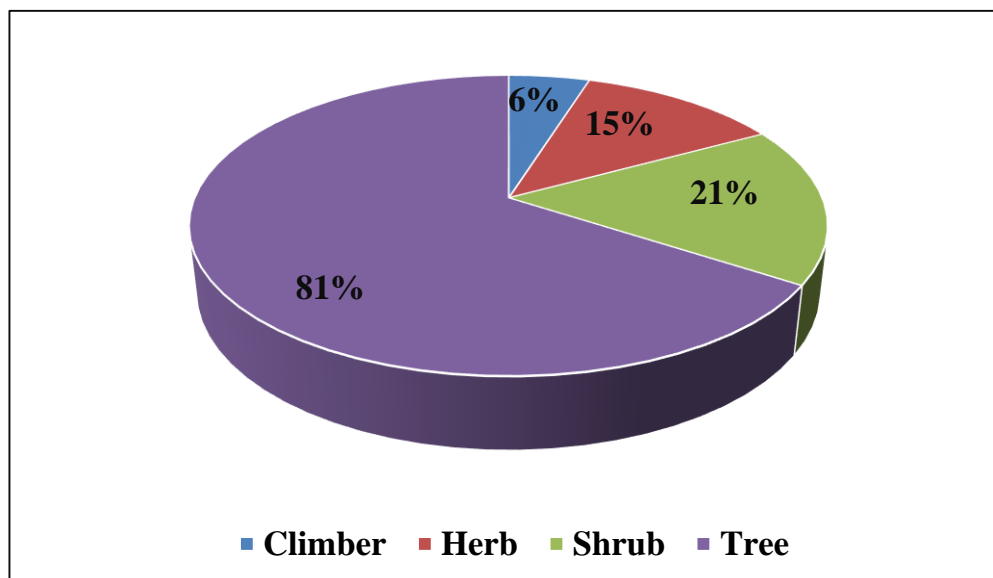
The campus has 33 invasive species such as *Senna spectabilis*, *Hypoestes phyllostachya*, *Maesopsis eminii*, *Mikania micrantha*, *Helianthus tuberosus*, *Hieracium umbellatum*, *Hamelia patens*, *Jatropha integerrima*, *Lantana camara*, *Eupatorium cannabinum* *Solanum violaceum*, *Calophyllum inophyllum* and *Roystonea regia*. These invasive species are indicated as disturbances to the natural setting in the vegetated areas.

The alien / exotic species viz., *Tabernaemontana divaricata*, *Muntingia calabura*, *Pyrostegia venusta*, *Cassia siamea*, *Annona squamosa* occur in the campus. Two Threatened species such as *Manilkara elengi* and *Swietenia mahagoni* were also observed in the campus.

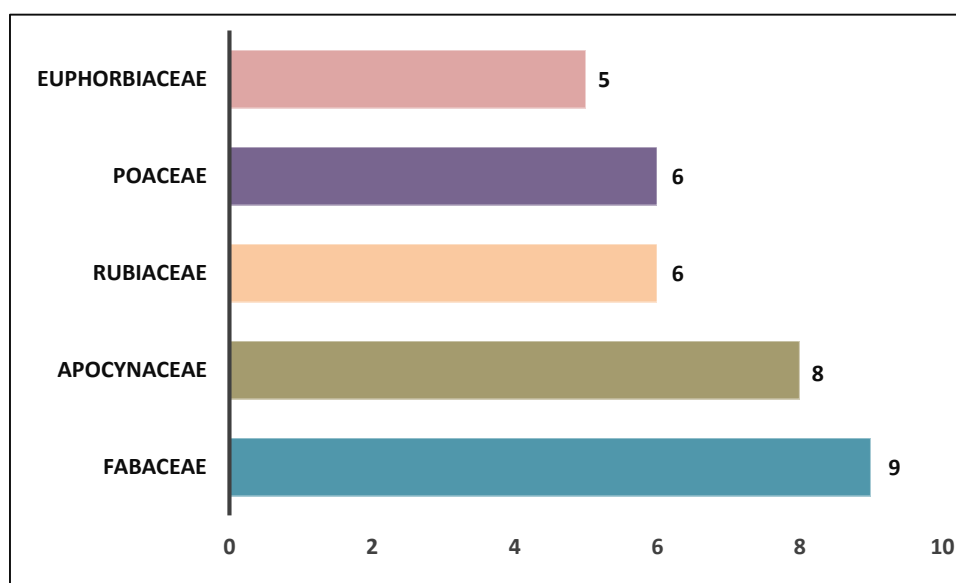
Some of the species are utilized as fruit yielding like *Mangifera indica*, *Manilkara zapota*, *Musa paradisiaca*, *Phyllanthus acidus*, *Syzygium cumini*, *Syzygium fruticosum*, *Phyllanthus emblica*, *Prunus amygdalus* and *Psidium guajava*.



**Systematic groups of the plants in the AIT campus**



#### Analysis of habit-wise distribution of plant species in the campus area



#### Plant families with higher number of species in the campus area

The biodiversity of AIT Campus comprises a sum of 123 species belonging to 72 genera under 52 families besides the lichens, mycoflora, pteridophytes and bryophytes. Among the documented higher plants, Dicots are dominating with 70 % followed by monocots 30%. Over all analysis revealed that trees weredominating flora (81%) followed by herbs, shrubs and climbers which accounts 15, 21 and 6 respectively. Among the documented dicots, Polypetalae formed a majorproposition with 25 families, 27 genera and 60 species; Gamopetalae with 10 families, 23 genera and 28 species while Monochlamydeae with 10 families, 12 genera and 20 species. In monocots, spreading over 10 genera belonging to 15 species. At the time of green campus audit at AIT campus, a total of 33 invasive floral species were recorded. These invasive species show disturbances to the natural setting in the vegetated sector.



**Table 5. List of Flowering plants in the AIT Campus**

Sl. No	Common Name	Botanical Name	Family	Habitats
1	Monkey Bush	<i>Abutilon indicum</i>	Malvaceae	Shrub
2	Auri	<i>Acacia auriculiformisa</i>	Mimosaceae	Tree
3	Goat Weed	<i>Ageratum conyzoides</i>	Asteraceae	Herb
4	Floss Flower	<i>Ageratum houstonianum</i>	Asteraceae	Tree
5	Women's tongue	<i>Albizia lebbek</i>	Mimosaceae	Tree
6	Allamanda	<i>Allamanda cathartica</i>	Apocyanaceae	Climber
7	White cheesewood	<i>Alstonia scholaris</i>	Apocynaceae	Tree
8	Sessile joyweed	<i>Alternanthera sessilis</i>	Amaranthaceae	Herb
9	Soursop	<i>Annona muricata</i>	Annonaceae	Tree
10	Custard apple	<i>Annona reticulata</i>	Annonaceae	Tree
11	Sugar Apple	<i>Annona squamosa</i>	Annonaceae	Tree
12	Burflower - tree	<i>Anthocephalus chinensis</i>	Rubiaceae	Tree
13	Black currant tree	<i>Antidesma ghaesmbilla</i>	Phyllanthaceae	Tree
14	Aloewood	<i>Aquilaria malaccensis</i>	Thymelaeaceae	Tree
15	Christmas Tree	<i>Araucaria columnaris</i>	Araucariaceae	Tree
16	Norfolk Island pine)	<i>Araucaria heterophylla,</i>	Araucariaceae	Tree
17	Ganges Primrose	<i>Asystasia gangetica</i>	Acanthaceae	Herb
18	Star fruit	<i>Averrhoa carambola</i>	Oxalidaceae	Tree
19	Neem	<i>Azadirachta indica</i>	Meliaceae	Tree
20	Orchid tree	<i>Bauhinia variegata</i>	Fabaceae	Tree
21	Common bamboo	<i>Bambusa vulgaris</i>	Poaceae	Tree
22	Thorny bamboo	<i>Bambusa arundinacea</i>	Poaceae	Herb
23	Silk cotton tree	<i>Bombax insigne</i>	Malvaceae	Tree
24	Toddy Palm	<i>Borassus flabellifer</i>	Arecaceae	Tree
25	Gray Nicker	<i>Caesalpinia bonducella</i>	Caesalpinaceae	Shrub
26	Peacock flower	<i>Caesalpinia pulcherrima</i>	Caesalpinaceae	Shrub
27	Leopard tree	<i>Caesalpinia ferrea</i>	Fabaceae	Tree
28	Alexandrian laurel balltree	<i>Calophyllum inophyllum</i>	Calophyllaceae	Tree
29	Giant milkweed	<i>Calotropis gigantea</i>	Apocynaceae	Shrub
30	Apple of Sodom	<i>Calotropis proceri</i>	Apocynaceae	Shrub
31	Wild guava	<i>Careya arborea</i>	Lecythidaceae	Tree
32	Papaya	<i>Carica papaya</i>	Caricaceae	Tree

33	Golden Shower Tree	<i>Cassia fistula</i>	Mimosaceae	Tree
34	Kassod tree	<i>Cassia siamea</i>	Fabaceae	Tree
35	Periwinkle	<i>Catharanthus roseus</i>	Apocynaceae	Shrub
36	Feather finger	<i>Chloris virgata</i>	Poaceae	Herb
37	Swollen finger grass	<i>Chloris barbata</i>	Poaceae	Herb
38	Lemon	<i>Citrus limon</i>	Rutaceae	Tree
39	Mandarian orange	<i>Citrus reticulata Blanco</i>	Rutaceae	Tree
40	Clausaena	<i>Clausaena heptaphylla</i>	Rutaceae	Tree
41	Aparajita vine	<i>Clitoria ternatea</i>	Fabaceae	Climber
42	Coconut tree	<i>Cocos nucifera L.</i>	Arecaceae	Tree
43	Rangoon creeper	<i>Combretum indicum</i>	Combretaceae	Climber
44	Sago palm	<i>Cycas revoluta</i>	Cycadaceae	Tree
45	Bermudagrass	<i>Cynodon dactylon</i>	Poaceae	Herb
46	Coco-grass	<i>Cyperus rotundus</i>	Cyperaceae	Herb
47	Rice sedge	<i>Cyperus difformis</i>	Cyperaceae	Herb
48	Basterd Rosewood	<i>Dalbergia lanceolaria</i>	Fabaceae	Tree
49	Flame of the forest	<i>Delonix regia</i>	Caesalpinaceae	Tree
50	Sweet William	<i>Dianthus barbatus</i>	Caryophyllaceae	Herb
51	Clove pink	<i>Dillanthus caryophyllus.</i>	Caryophyllaceae	Tree
52	Ebony	<i>Diospyros montana</i>	Ebenaceae	Tree
53	Abyssinian Gooseberry	<i>Dovyalis abyssinica</i>	Salicaceae	Tree
54	Indian olive	<i>Elaeocarpus floribundus</i>	Elaeocarpaceae	Tree
55	Money plant	<i>Epipremnum aureum</i>	Areceae	Climber
56	Lemon-scented gum	<i>Eucalyptus citriodora</i>	Myrtaceae	Tree
57	Tasmanian blue gum	<i>Eucalyptus globosus</i>	Myrtaceae	Tree
58	Indian tree Spurge	<i>Euphorbia tirucalli</i>	Euphorbiaceae	Tree
59	Mexican fire plant	<i>Euphorbia heterophylla</i>	Euphorbiaceae	Tree
60	The common fig	<i>Ficus carica</i>	Moraceae	Tree
61	Hairy fig	<i>Ficus hispida</i>	Moraceae	Tree
62	Scared fig tree	<i>Ficus religiosa</i>	Moraceae	Tree
63	Coffee plum	<i>Flacourtia jangomus</i>	Flacourtiaceae	Tree
64	Giant Cabuya	<i>Furcraea foetida</i>	Asparagaceae	Shrub
65	Female karata	<i>Furcraea tuberosa</i>	Asparagaceae	Shrub
66	White teak	<i>Gmelina arborea</i>	Verbenaceae	Tree
67	Silky Oak	<i>Grevillea robusta</i>	Proteaceae	Tree

68	Firebush	<i>Hamelia patens</i>	Rubiaceae	Shrub
69	Jerusalem artichoke	<i>Helianthus tuberosus</i>	Astraceae	Herb
70	Chinese hibiscus	<i>Hibiscus rosa-sinensis</i>	Malvaceae	Shrub
71	Roselle	<i>Hibiscus sabdariffa</i>	Malvaceae	shrub
72	Pignut	<i>Hyptis suaveolens</i>	Lamiaceae	Shrub
73	Arabian Nights	<i>Jasminum sambac</i>	Oleaceae	Shrub
74	Peregrina	<i>Jatropha integerrima</i>	Euphorbiaceae	Shrub
75	Pride of India	<i>Lagerstroemia speciosa</i>	Lythraceae	Tree
76	The Indian ash tree	<i>Lannea coromandalica</i>	Anacardiaceae	Tree
77	Common Lantana	<i>Lantana camara</i>	Verbenaceae	Shrub
78	Saipan mango	<i>Mangifera odorata</i>	Anacardiaceae	Shrub
79	Mango tree	<i>Mangifera indica</i>	Anacardiaceae	Tree
80	Bullet wood	<i>Manilkara elengi</i>	Sapotaceae	Tree
81	Sapota	<i>Manilkara zapota</i>	Sapotaceae	Tree
82	Chinaberry tree	<i>Melia azedarach</i>	Meliaceae	Tree
83	Champak	<i>Michelia champaca</i>	Magnoliaceae	Tree
84	Touch-me-not	<i>Mimosa pudica</i>	Fabaceae	Shrub
85	Tanjong Tree	<i>Mimusops elengi</i>	Sapotaceae	Tree
86	Indian mulberry	<i>Morinda citrifolia</i>	Rubiaceae	Tree
87	Indian mulberry	<i>Morinda tinctoria</i>	Rubiaceae	Tree
88	Drumstick tree	<i>Moringa oleifera</i>	Moringaceae	Tree
89	Cherry Tree	<i>Muntingia calabura</i>	Muntingiaceae	Tree
90	Curry Leaf Tree	<i>Murraya koenigii</i>	Rutaceae	Tree
91	Banana	<i>Musa paradisiaca</i>	Musaceae	Tree
92	Night flowering jasmine	<i>Nyctanthes arbor-tristis</i>	Oleaceae	Tree
93	Diamond flower	<i>Oldenlandia corymbosa</i>	Rubiaceae	Herb
94	Chay root	<i>oldenlandia umbellata</i>	Rubiaceae	Herb
95	Tree bean	<i>Parkia roxburghii</i>	Mimosaceae	Tree
96	Passion flower vine	<i>Passiflora incarnata</i>	Passifloraceae	Climber
97	Copperpod	<i>Peltophorum pterocarpum</i>	Caesalpiniaceae	Tree
98	Date palm	<i>Phoenix canariensis</i>	Arecaceae	Tree
99	Otaheite Gooseberry	<i>Phyllanthus acidus</i>	Phyllanthaceae	Tree
100	Indian goose berry	<i>Phyllanthus emblica</i>	Phyllanthaceae	Tree
101	Bridal Bouquet	<i>Plumeria pudica</i>	Apocynaceae	Shrub
102	Great White Frangipani	<i>Plumeria obtusa</i>	Apocynaceae	Shrub

103	Asoka tree	<i>Polyalthia longifolia</i>	Annonaceae	Tree
104	Indian kino	<i>Pterocarpus marsupium</i>	Fabaceae	Tree
105	Red Sandal wood	<i>Pterocarpus santalinus</i>	Fabaceae	Tree
106	Pomegranate	<i>Punica granatum</i>	Lythraceae	Tree
107	Sandal wood	<i>Santalum album</i>	Santalaceae	Tree
108	Agati	<i>Sesbania grandiflora</i>	Fabaceae	Tree
109	Toothbrush tree	<i>Streblus asper</i>	Moraceae	Tree
110	False lime	<i>Suregada multiflora</i>	Euphorbiaceae	Tree
111	American mahogany	<i>Swietenia mahagoni</i>	Meliaceae	Tree
112	Rose Apple	<i>Syzygium jambos</i>	Myrtaceae	Tree
113	Pinwheel Flower	<i>Tabernaemontana divaricata</i>	Apocynaceae	Shrub
114	Teak	<i>Tectona grandis</i>	Lamiaceae	Tree
115	Yellow bells	<i>Tecoma stans</i>	Bignoniaceae	Climber
116	Toon tree	<i>Toona ciliate</i>	Meliaceae	Tree
117	Pigeon wood	<i>Trema orientalis</i>	Cannabaceae	Tree
118	False White teak	<i>Trewia nudiflora</i>	Euphorbiaceae	Tree
119	Yellow alder	<i>Turnera ulmifolia</i>	Turneraceae	Herb
120	White buttercup	<i>Turnera subulata</i>	Turneraceae	Herb
121	Zunna berry	<i>Ziziphus glabrata</i>	Rhamnaceae	Tree
122	Indian jujube	<i>Ziziphus mauritiana</i>	Rhamnaceae	Tree
123	Jackel jujube	<i>Ziziphus oenoplia</i>	Rhamnaceae	Shrub



*Dypsis lutescens*



*Cycas revoluta*



*Phoenix reclinata*



*Quercus myrsinifolia*



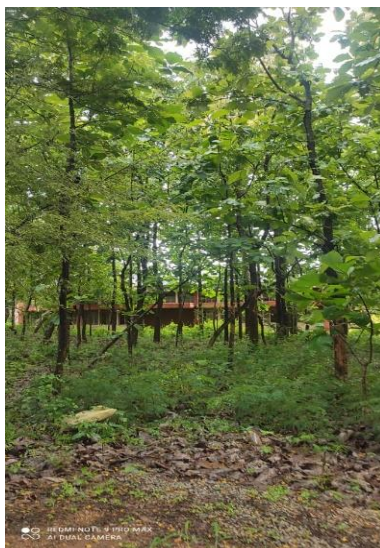
*Junglans olanchana*



*Phyllostachys aureosulcata*



*Dracaena fragrans*



*Tectona grandis*



*Agapanthus sp*

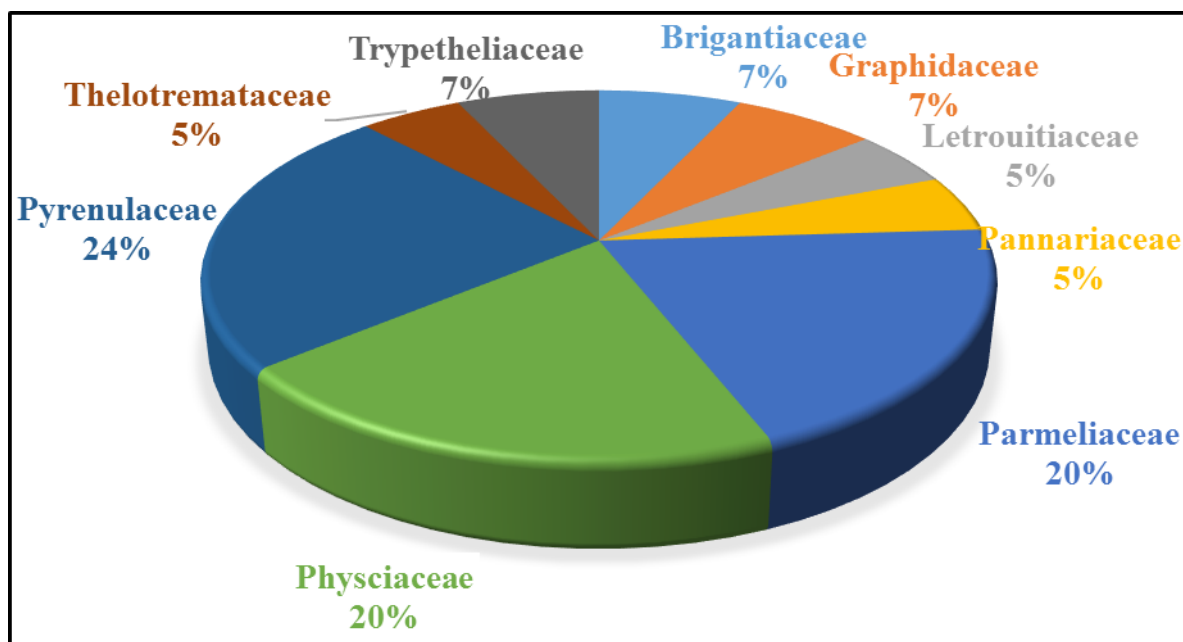
### 13.3.1.2. Lichen diversity in the AIT College campus

Lichens are one of the most fascinating symbiotic organisms found worldwide. The lichens species are ubiquitous and common inhabitants of the bark of the tree, rock surface, soil etc. They are a lower group of plants coming under non-flowering plants that live in a variety of substrates under a wide range of environmental conditions with or without causing harm to the hosts. Ecologically, lichen plays important roles in soil formation; re-establishes life on earth; fixes atmospheric nitrogen; plant's health, ecology distribution, and in the formation of organic matter of habitat which in turn benefitting mosses in nutrient availability. A unique synergetic association between a fungal and an algal species results in lichens and occupied in plant kingdom. In this relationship both the organisms are mutually benefited.

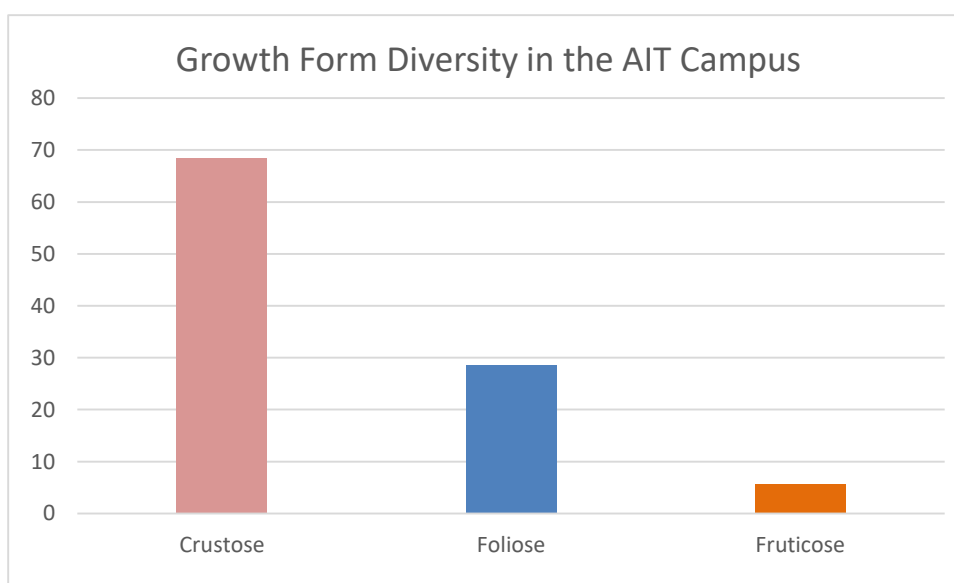
The algal partner may be cyanobacteria or the blue green algae and this is responsible for the process of photosynthesis. The algae thus provide food or nutrition for the fungi too. The fungal partner in turn provides space and protection for the algae. The lichen is an autotrophic organism in the sense that they can produce their own food by the process of photosynthesis. Even though the lichen is made up of two different organisms, the characteristics of the lichen are entirely different from the original characteristics of the algal and the fungal partner. Lichens are classified as micro lichens and macro lichens in which the microlichens cover the substrate on which they grow in the form of a crust whereas macro lichens grow in the form of a bush or a leaf like structure. The major forms of lichens are a) Foliose lichens exhibit a flat leaf like thallus, b) Fruticose lichens exhibit erect, pendulous and bushy thallus and c) Crustose lichens exhibit flat crust shaped thallus.



Lichen diversity recorded in the AIT campus showed a total of 25 different lichens species representing 16 genera and 11 families. The observation on lichen diversity revealed that three types of lichens growth forms. The lichens belonging to the genus, *Brigantiaea*, *Buellia*, *Trypethelium*, *Letrouitia* *Anthracothecium* *Pyrenula* and *Graphis* sp. were accounted 68% diversity coming under crustose lichens. Ten species of foliose lichens belonging to the genus, *Pannaria* *Canoparmelia*, *Parmotrema*, *Hypotrachyna*, *Pyxine* and *Physcia* were accounted to about 28% of lichens. One single species of *Usnea* accounted for fruticose lichens.



### Lichen Families in AIT Campus



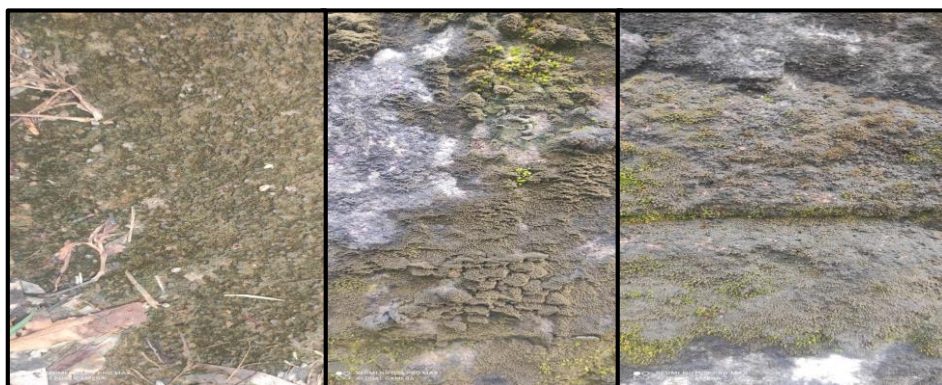
**Table 6. Lichen diversity of the AIT campus with respect to family, substratum and growth forms in genus and family wise classification**

S. No	Lichen diversity	Family	Growthforms
1.	<i>Anthracothecium assamiense</i>	Pyrenulaceae	Crustose
2.	<i>Anthracothecium corticatum</i>	Pyrenulaceae	Crustose
3.	<i>Anthracothecium macrosporum</i>	Pyrenulaceae	Crustose
4.	<i>Brigantiaea leucoxantha</i>	Brigantiaceae	Crustose
5.	<i>Brigantiaea nigra</i>	Brigantiaceae	Crustose
6.	<i>Buellia conformis</i>	Physciaceae	Crustose
7.	<i>Canoparmelia texana</i>	Parmeliaceae	Foliose
8.	<i>Usnea undulata</i>	Parmeliaceae	Fruticose

9.	<i>Usnea pictoides</i>	Parmeliaceae	Fruticose
10.	<i>Trypethelium tropicum</i>	Trypetheliaceae	Crustose
11.	<i>Trypethelium eluteriae</i>	Trypetheliaceae	Crustose
12..	<i>Pyxine minuta</i>	Physciaceae	Foliose
13.	<i>Pyxine cocoes</i>	Physciaceae	Foliose
14..	<i>Pyrenula subglabriuscula</i>	Pyrenulaceae	Crustose
15.	<i>Pyrenula nitens</i>	Pyrenulaceae	Crustose
16.	<i>Pyrenula interducta</i>	Pyrenulaceae	Crustose
17.	<i>Physcia tribacia</i>	Physciaceae	Foliose
18.	<i>Physcia alba</i>	Physciaceae	Foliose
19.	<i>Phaeographina wattiana</i>	Graphidaceae	Crustose
20..	<i>Pannaria stylophora</i>	Pannariaceae	Foliose
21.	<i>Myriotrema terebrans</i>	Thelotremataceae	Crustose
22.	<i>Letrouitia domingensis</i>	Letrouitiaceae	Crustose
23.	<i>Hypotrachyna awasthii</i>	Parmeliaceae	Foliose
24.	<i>Graphis guimarana</i>	Graphidaceae	Crustose
25.	<i>Everniastrum nepalense</i>	Parmeliaceae	Foliose

### 13.3.3. Algal diversity in the AIT campus

*Microcystis*, *Oscillatoria*, *Oedogonium*, *Spirogyra*, *Volvox*, *Chlamydomonas*, *Scytonema* and *Cladophora spp.* belonging to the class of Cyanophyceae, Chlorophyceae and Bacillariophyceae are the predominant species found in the campus.



The families Chlorellaceae, Closteriaceae, Desmidiaceae, Radiococcaceae, Ulotrichaceae, Uronemataceae and Oedogoniaceae were represented by single genus and species. Chlorophyceae plays an important role in both terrestrial and aquatic ecosystem as most of the members are found to be ecologically important. The highest diversity of Chlorophyceae indicated relatively good health of atmosphere. The presence of these algal species in abundance can be concluded that the AIT Campus ecosystem has high amount of organic nutrients in soil and rock. Generally, occurrence of abundant algal flora at a place indicates the availability of abundant nutrients along with conducive favourable environmental conditions.

#### 13.3.1.3. Mushrooms diversity in the AIT campus

Mushrooms, edible basidiomycete, represent white rot fungi which contained higher number of proteins, rich in minerals with medicinal properties. At present three mushroom varieties (white mushroom, the paddy-straw mushroom and the oyster



mushroom) are being cultivated in India. These are most popular, economically sound to grow and is extensively cultivated throughout the world. Due to moderate temperature requirement for luxuriant growth, its cultivation is restricted to the cool climatic zones and during winter months in the plains of Coimbatore region. Mushroom growth yield is influenced by the type of compost, spawn, temperature, percentage of moisture and also affected by the pests and disease-causing agents. There has been extensive discussed in recent years, as far as the production of fungal protein from domestic, agricultural and industrial wastes. Since mushrooms have a very short life span, it should reach to consumers within a short time or immediately canned. Mushroom growth is determined by means of carbohydrate content in the substrates like paddy straw, sugarcane molasses, saw wood dust and other plant waste materials.

The AIT campus has various mushroom types covering poisonous, edible and medicinal varieties such as white mushroom (*Agaricus bisporus* and *A. laccata*), the paddy-straw mushroom (*Volvariella volvacea*), oyster mushroom (*Pleurotus sajor-caju* and *P. florida*), button mushroom (*Omphalotus olearius*) and other mushroom types such as *Amauroderma conjunctum*, *Termitomyces fuliginosus*, *Pycnoporus cinnabarinus* and *Volvariella bombycina*.

### 13.3.2. Fauna Diversity in the AIT campus

#### 13.3.2.1. Birds Diversity in the AIT campus

The observations on fauna diversity indicated that the AIT campus has a large number of living as well as visiting animals, birds, reptiles and insects including termites. A total number of 20 birds belonging to 15 different species representing 12 families and 10 orders were recorded from different habitats during winter and summer. During this study, Passeriformes constituted the predominating group representing 8 families. Out of 20 bird species, 10 species were found to be migratory to favourable environment and high availability of food resources.

**Table 7. Birds Diversity in the AIT campus**

S.No	Common Name	Scientific Name
1.	Lesser Whistling Teal	<i>Dendrocygna javanica</i>
2.	Asian Openbill Stork	<i>Anastomus oscitans</i>
3.	Indian Pond Heron	<i>Ardeola grayii</i>
4.	Little Egret	<i>Egretta garzetta</i>
5.	Black Kite	<i>Milvus migrans</i>
6.	Common Pigeon	<i>Columba livia</i>
7.	Common Myna	<i>Acridotheres tristis</i>
8.	Oriental Magpie Robin	<i>Copsychus saularis</i>
9.	Asian Pied Myna	<i>Gracupica contra</i>
10.	House Sparrow	<i>Passer domesticus</i>
11.	Eurasian Tree Sparrow	<i>Passer montanus</i>
12.	Spotted Dove	<i>Spilopelia chinensis</i>
13.	Eastern Jungle Crow	<i>Corvus levaillantii</i>

14.	Greater Flameback	<i>Chrysocolaptes guttacristatus</i>
15.	Purple sunbird	<i>Cinnyris asiaticus</i>

**Table 8. Total number of visiting birds in the AIT campus**

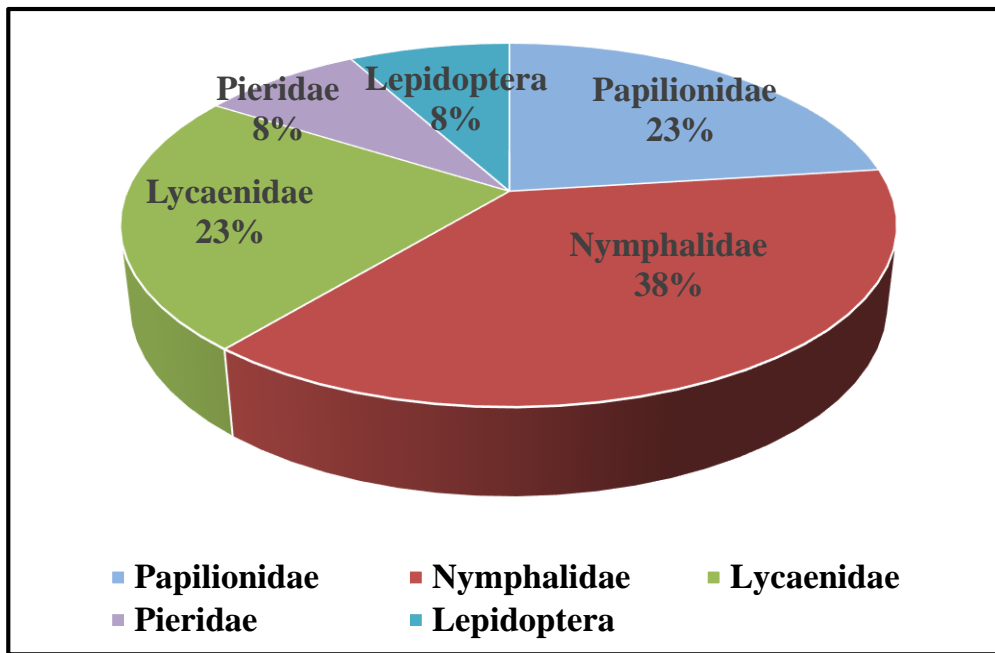
S.No	Common Name	Scientific Name
1.	Little Cormorant	<i>Phalacrocorax niger</i>
2.	Common Kingfisher	<i>Alcedo atthis</i>
3.	Green bee-eater	<i>Merops orientalis</i>
4.	Red vented Bulbul	<i>Pycnonotus cafer</i>
5.	Black Drongo	<i>Dicrurus macrocercus</i>

### 13.3.2.2. Butterflies' diversity in the AIT campus

The AIT campus has five family level diversities such as Papilionidae, Pieridae, Nymphalidae, Lycaenidae and Hesperidae in which Common butterflies' species such as Mormon, Emigrant, Pansy are commonly found.

**Table 9. List of Butterflies recorded in the AIT campus**

S.No.	Common Name	Scientific Name	Family
1.	Common Mormon	<i>Papilio polytes</i>	Papilionidae
2.	Great Mormon	<i>Papilio memnon</i>	Papilionidae
3.	Common Birdwing	<i>Troides helena</i>	Papilionidae
4.	Chocolate Pansy	<i>Junonia iphita</i>	Nymphalidae
5.	Lemon Pansy	<i>Junonia lemonias</i>	Nymphalidae
6.	Common Sailor	<i>Neptis hylas</i>	Nymphalidae
7.	Common pierrot	<i>Talicauda nyseus</i>	Lycaenidae
8.	Lemon emigrant	<i>Catopsilia pomona</i>	Pieridae
9.	Common seargent	<i>Athyma perius</i>	Nymphalidae
10.	Common lescar	<i>Pantoporia hordonia</i>	Nymphalidae
11.	Jezelbel	<i>Delias eucharis</i>	Lepidoptera
12.	Limeblue	<i>Chilades lajus</i>	Lycaenidae
13.	Tiny Grass Blue	<i>Zizula hylax</i>	Lycaenidae



### Butterfly Diversity in the AIT campus

#### 13.3.2.3. Mammals' diversity in the AIT campus

Mammals, a group of vertebrate animals (class: Mammalia), characterized by the presence of mammary glands (where females produce milk for feeding/nursing their young), a neocortex (a region of brain), fur or hair and three middle ear bones. These characteristic features differentiate them from reptiles and birds. Observation on diversity of mammals in the AIT campus indicated that around 6 Mammal genera are commonly distributed.

#### 13.3.2.4. Amphibians' diversity in the AIT campus

Amphibians (class: Amphibia) are ectothermic, tetrapod vertebrates. All living amphibians represent the group Lissamphibia and they inhabit a wide variety of habitats. Most of them living within terrestrial, fossorial, arboreal or freshwater aquatic ecosystems. Amphibians naturally start out as larvae living in water, but some species bypass this by developed behavioral adaptations. Observation made on diversity of Amphibians in the AIT indicated that around 3 species are Amphibians are commonly distributed.

Generally, amphibians undergo metamorphosis from larva with gills to air-breathing adult with lungs. Skin of the Amphibians served as a secondary respiratory organ while very few terrestrial salamanders and frogs lack lungs and they rely entirely on their skin for respiration. With their complex reproductive needs and permeable skins, amphibians are often ecological indicators. In recent decades, there has been a drastic decline in populations of many amphibian species around the globe.

Historically, amphibians evolved in the Devonian period from sarcopterygian fish with lungs and bony-limbed fins, which were helpful them to adapt to dry land conditions. Their spread was higher and predominant during Carboniferous and Permian periods and they were later displaced by reptiles and other vertebrates. Over a period, amphibians shrank in size and their diversity decreased drastically, leaving only the modern subclass Lissamphibia. Modern amphibian orders include Anura (the frogs), Urodela (the salamanders) and Apoda (the caecilians). Number of known amphibians species is nearly 70% are frogs. Observation made in the AIT Campus on diversity of

Amphibians revealed that around 3 species of Amphibians are commonly disseminated. The commonly found amphibians are Common Toad (*Duttaphyrnus melanosticus*), Common Tree Frog (*Polypedates teraiensis*) and Pygmy Toad (*Microhyla berdmorei*).

#### **13.3.2.5. Grasshopper diversity in the AIT Campus**

Grasshoppers, a group of insects belonging to the suborder Caelifera and they are probably most ancient living group of chewing herbivorous insects. They are typically ground-dwelling insects with powerful hind legs which allow them to escape from threats by leaping dynamically. As a hemimetabolous insects, they do not undergo complete cycle of metamorphosis. In other word, they hatch from an egg into a nymph or "hopper" which undergoes five moults, to become identical to that of an adult. Grasshoppers hear through the tympanal organ which can be found in the first segment of the abdomen attached to the thorax; its sense of vision is compound eyes. Under certain environmental conditions, some grasshopper species at high population densities can change colour and behaviour besides form swarms. Grasshoppers are plant-eaters; few species at times become as a serious pest of cereals, vegetables and pasture, especially when they swarm to destroy the crops over huge contiguous areas. Surveillance audit at AIT campus on diversity of Grasshoppers demonstrated that 6 species of Amphibians are commonly distributed which includes *Eyprepocnemis alacris*, *Cyrtacanthacris tartarica*, *Crucinotacris decisa*, *Aulacobothrus luteipes* and *Sathrophyllia rugosa*

#### **13.3.2.6. Termites Diversity in the AIT Campus**

Termites are most successful groups of insects on earth, colonising most landmasses. Their colonies range in size from a few hundred individuals to enormous societies with several million individuals. Eusocial insects, commonly Termites, are taxonomically ranking as infraorder. Isoptera, or alternatively as epifamily Termitoidae, within the order Blattodea (along with cockroaches). Although Termites are habitually known as "white ants", they are not ants and they are not closely related with them. Earlier, Termites were classified as a separate order from cockroaches. Recent phylogenetic studies revealed that they evolved from cockroaches, as they are deeply nested within the group and the sister group found to wood eating cockroaches of the genus *Cryptocercus*. More recent estimates suggest that they have originated during the Late Jurassic period evidenced with the first fossil records in the Early Cretaceous. Termites mostly nourish on cellulose based dead plant material (wood, leaf litter), soil and animal dung. Three species of Termites (*Odontotermes anamallensis*, *Trivitermes fletcheri* and *Nasutitermes indicola*) recorded during on-site Green Campus audit at campus and they are belonging to the Genera *Odontotermes*, *Trivitermes* and *Nasutitermes*.

### 13.4. An account of more Oxygen releasing and Carbon dioxide assimilating plants in the AIT Campus

There are some plants which are being considered highly efficient in oxygen releasing and carbon dioxide assimilating (Carbon sinks) which in turn reflected the quality of the green campus. If more oxygen is made available in the campus naturally, the stakeholders may be free from various cardiovascular and pulmonary problems and breathing troubles. *Sansevieria zeylanica* (commonly known as snake plant or the mother-in-law's tongue plant) and Gerbera Daisy (*Gerbera jamesonii*) plants are unique for oxygen release during night time and they are able to purify the atmospheric air in terms of removal of toxic gases. Although options are available to enhance the level of oxygen by reducing CO<sub>2</sub> with the aid of oxygenators and air purifiers, there are certain alternatives to improve the air quality which is beneficial for both body and mind. Green campus audit at AIT campus revealed that the campus is well distributed with more oxygen releasing and CO<sub>2</sub> assimilating plants such as Neem, Tasmanian blue gum, Java Plum/Jamun, Arjun tree, Pipal Tree, Asoka tree, Banyan tree, Tanjong Tree, Curry Leaf Tree, Mango tree and Teak. There are 11 plant species which are able to create an eco-friendly atmosphere in terms of reducing erosion, moderating the climate, improving air quality and supporting wildlife besides they are economically important and valued for different medicinal aspects.

The ornamental plants such as Indian mulberry (*Morinda citrifolia*), Java Plum / Jamun (*Syzygium cumini*), Champak (*Michelia champaca*), Kassod tree (*Cassia siamea*) and White cheesewood (*Alstonia scholaris*) are made available. In addition, medicinal plants such as *Albizia lebbek*, *Annona squamosa*, *Azadirachta indica*, *Melia azedarach*, *Morinda tinctoria*, *Phyllanthus emblica*, *Pterocarpus marsupium*, *Tabernaemontana divaricate* and *Tectona grandis* are available in the



**Oxygen releasing and Carbon dioxide assimilating plants in the AIT Campus**

**Table 10. List of Oxygen releasing and Carbon dioxide assimilating, Ornamental / Medicinal plants in the AIT Campus**

S.No	Plant Name (Kanada Name)	Plant Name (English)	Scientific Name	Grouping / Nature	Characteristic Features of the plant
1.	Bevina mara	Neem	<i>Azadirachta indica</i>	Dicots	O <sub>2</sub> releasing Plant
2.	Ṭyāsmēniyan nīli gam	Tasmanian blue gum	<i>Eucalyptus globosus</i>	Dicots	CO <sub>2</sub> assimilating Plant / Medicinal Plant
3.	Nerale Hannu	Java Plum/Jamun	<i>Syzygium cumini</i>	Dicots	Ornamental Plant
4.	Matthimara	Arjun tree	<i>Terminalia arjuna</i>	Dicots	O <sub>2</sub> releasing Plant
5.	Arashi	Pipal Tree/Sacred Fig	<i>Ficus religiosa</i>	Dicots	O <sub>2</sub> releasing Plant
6.	Achenge	Asoka tree	<i>Polyalthia longifolia</i>	Dicots	CO <sub>2</sub> assimilating Plant
7.	Aalada mara	Banyan tree	<i>Ficus benghalensis</i>	Dicots	O <sub>2</sub> releasing Plant
9.	Karibevu	Curry Leaf Tree	<i>Murraya koenigii</i>	Dicots	O <sub>2</sub> releasing Plant
10.	Amangara gida	Mango tree	<i>Mangifera indica</i>	Dicots	O <sub>2</sub> releasing Plant
11.	Thega/ Saguvani	Teak	<i>Tectona grandis</i>	Dicots	CO <sub>2</sub> assimilating Plant

### 13.5. Lawns, Trees, Herbs, Shrubs, Climbers and Lianas in the AIT Campus

Lawns are gazing features of unutilized land made to cover the soil with green grass for the ambience of the place to have a greenish look. Lawn provides a hollow space among the building structures. The shaded trees in between the grass lawn, pathways and garden benches are meaningful lineaments to the green campus. The advantage of lawn is that it prevents the unintended weeds growth in the unutilized landscape areas. Trees that are native to land with medicinal value, ethnicity and environmental value add an advantage to green building. Purpose of trees is to provide shade, atmospheric CO<sub>2</sub> sequestration and supply of oxygen that serves the purpose of a green campus. Herbs are small plants with medicinal values and shrubs are small plants with thick stems and can hold soil to some extent than the herbs and serve the purpose of soil erosion. Climbers can grow with the support of wall structures and the climbers can enhance the wall value with greeneries.

The AIT campus has a huge number of trees, herbal plants, bushes, climbers, lianas, twiners and lawns. It is further observed that all the plants are growing profusely and showing healthier free from pests and diseases attack. The commonly available native as well as wild shrub species in the AIT campus are Monkey Bush (*Abutilon indicum*), Blue weed (*Ageratum houstonianum*), Peacock flower (*Caesalpinia pulcherrima*), Red Powder Puff (*Calliandra haematocephala*), Indian shot (*Canna indica*), Periwinkle (*Catharanthus roseus*), Rusty kamala (*Mallotus stragosa*), Elm-Leaf Grewia (*Microcos panicula*) and Lily of the Valley shrub (*Pieris japonica*)

Similar to that of shrubs, there are 21% kinds of herbs available in the AIT campus. The predominant species of herbs available in the AIT campus are Ganges Primrose (*Asystasia gangetica*), Lamb's quarters (*Chenopodium album*), Common twayblade (*Neottia ovata*), Diamond flower (*Oldenlandia corymbosa*) and Upright pellitory (*Parietaria officinalis*)

The existence of climber, creepers, twiners and lianas species available which accounted more than 6 species in the AIT campus are Allamanda (*Allamanda cathartica*), Aparajita climbing vine (*Clitoria ternatea*), Rangoon creeper (*Combretum indicum*), Money plant (*Epipremnum aureum*), Flame plant (*Pyrostegia venusta*) and Bengal clock plant (*Thunbergia grandiflora*). The major grasses are Periapullu (*Aristida pinnata*) and Crowfoot grass (*Dactyloctenium aegyptium*). Weak stemmed creeper plants grow alongside the ground, depends another plant support, or climb up a wall by means of extending stems or branches. Climbers, include herbs or shrubs, whose stems are weak, which needs support to grow, where it climbs up trees and walls and grow vigorously without any pest and disease attack which are observed in the AIT campus.

### 13.6. Establishment of different Gardens in the AIT Campus

Growing many types of herbal plants having medicinal importance in the campus becomes more attractive and useful if concept gardens are maintained. Medicinal plant gardens can contain the locally available medicinal plants, RET (Rare Endangered Threatened) listed plants and those plants are most useful in terms of economic importance. The tree garden / arborea can be planted based on the zodiac signs which

would attract the public and students, faculties, staff members, employees and educate them based on their uses. In the tree gardens, trees as linings all over the campus can act as oxygen corridors. Native trees along with trees like *Azadirachta* and *Ficus* species can be cultivated at the maximum as these plants are used to remove the dust particles and carbon lead from the air and purifies the air considerably. Similarly, the ornamental plants with beautiful flowers can be maintained in the frontage garden of campus for attraction and good ambience. This will give an overall aesthetic look and also provide fresh air for healthy respiration to the stakeholders.

In AIT, they are planted ornamental plants for the display of appealing characteristic features including: varying types of leaves and their texture, flowers and their fragrance, fruit, stem and bark. In some places, plants unusual features also planted to be of interest, such as the prominent thorns of cactus and snake cactus. There are 10 varieties of ornamentals plants that are maintaining the surroundings of the college campus. In front of principal's room, cafeteria, college grounds and many places are planted with ornamentals plants of nearly 25 plants in different places. These plants are making the college campus pleasantly and decoratively. Every year they try to plant new varieties with help of Environmental department. Once in three months the unwanted barks of the plants are cut it down, to make the beautification of their campus. No plant is cut unless it becomes dead. Not only can visitors enjoy seeing the ornamentals plants and also humming birds, butterflies shelter in that. This environment makes campus greenish and pleasant.

### 13.7. Natural Topography and Vegetation

Natural topography means the original geographical features of the campus, around 30-35% of the organization should have the natural features like rocks, water resources, slopes, landscape, pathways, etc. and the altered topography can be accounted for, it is facilitated. The vegetation in the land alone is considered as they are part of the natural topography. The vegetation in the artificially created structures are also accounted for when it is reported more than 30% of the claimed green campus audit site. Vegetation is the cultivation of a bunch of plants irrespective of the plant *taxa* for the covering of the area or ground topography. Natural topography is better appreciated with wild vegetation than the artificially created topography like pathways and parking areas. The observation at the AIT campus indicated that more than 25% natural topography and vegetation have been maintained properly. Further, there was no anthropogenic activity in some of the interior side of the campus.

### 13.8. Rainwater Harvesting System and Percolation Pond

Rainwater harvesting system is a traditional old practice not only in drought prone areas and also in areas having seasonal rainfall. The Indian traditional rainwater harvesting is being practiced in various parts of the country to improve the ground water status. Now the threatening features of the lower ground level of water has created a revamp of newly featured rainwater harvesting systems. Indian traditional rainwater harvesting systems are constructed based on three modes either direct pumped, indirect pumped or by gravity alone in the campus. In addition, lakes, ponds, water channels and any other water reservoir methods are considered as the rainwater harvesting system. The green campus should have adopted any of the above said modes





of rainwater harvesting or any new methods that has the benefit of conserving the water resource as well. A small square shaped pit containing gravels and sands constructed near the building for rainwater harvesting and connected with pipes from the roof of the building to pit. During the audit, there was a well-developed rain harvesting system of water channels connected with a round shaped pit observed with the AIT campus. Rainwater harvesting structures and recharge wells have been commissioned in the campus at different locations.

### **13.9. Landscape design and Soil Erosion control**

Landscape management is the maintenance of land to make sure that backgrounds can fulfil the needs and objectives in an effective and sustainable manner for current and future members. It is an action that forms a perception of viable expansion, to ensure the preservation of a panorama, in order to help and harmonize alterations which are supplemented through social, monetary and environmental methods. Landscape design is an important feature for any disasters to control especially with respect to the soil erosion. In general, soil erosion occurs if the design of the land is not altered so as to prevent the slope features by strong vegetation and use of a plant buffer zone as safe for escape of nutrients or fertilizers entering the streams. When the slope features are altered, adequate vegetation can alone be enough to prevent soil erosion. The observation revealed that the A campus has very good landscape design without disturbing the natural vegetation. Contour ploughing is being done at right angles to the slope wherever possible and ridges and furrows are properly maintained to break the flow of water down to the empty land. These activities are widely adopted to control soil erosion in the campus.

### **13.10. Operation of Water irrigation, Drip and Sprinkler Irrigation methods**

Maintaining the green campus and water conservation mechanisms should be applied efficiently in the campus. Well planned water irrigation systems like sprinklers and drip should be implemented in the entire green area of the campus for an effective water management system. This can be implemented only when the plantations are well planned. The tree growing areas can be connected with drip irrigation and medicinal plants growing areas and flower gardens can be connected with sprinkler irrigation. The AIT campus has taken sufficient efforts to maintain the plants greenish and frequency of watering to the plants. A register is maintained to note down the timing of watering the plants and quantity of water poured every time. Internal auditing of time of plantation, number of times the plants are watered and growth parameters of the plants in the campus is being carried out.

### 13.11. Importance of Biodiversity Conservation

The campus should be a mini biodiversity conservation area, wherein, more greenery due to native plant species, medicinal plant garden, concept gardens, flowering plants that attract bees, birds, beetles and other animals like squirrels should be monitored as ecosystems. Shade giving trees in the paths, flowering trees in the avenues and fruit trees at the back yards also would attract birds, bees, butterflies and squirrels. The AIT campus is free of exotic plants that cause threat to the natural vegetation. It is like a mini bio-reserve rich in native species and endemic plants. A complete data on the soil type, water holding capacity and soil nutrition in the campus is being thoroughly studied internally or with the Government agriculture departments. It is useful for cultivation of various native and wild plant species and also helps in choosing the proper irrigation system.

### 13.12. Pedestrian Path facility at the AIT campus

The concept of pedestrian path is to give safe space to walk freely by the pedestrian. It is very important in the green campus in terms of freely walk pedestrians or people going on foot without any obstacles. The pedestrian path is otherwise called as zebra crossing by the combination of black and white stripes remained to characterize the zebra. This path is specially designed space to the stakeholders to walk freely without any disturbance. It is useful for cross walk and easy to recognize to walk by means of wide black and white colour combination of lines and authorize to walk while crossing and walking on the foot. In addition, pedestrian path is created in the green campus along with road side which meant for walking only using special cement bricks and stones. The pedestrian path aims to end circulation not only cars, buses, vans, trucks and other vehicles but also giving safe space to the pedestrians, where cross and pass-through blocks and also forcing vehicles to comply with it. The AIT campus is having very good pedestrian path for stakeholders.



### 13.13. Use of Biofertilizers, Organic and Green manures

Natural or eco-friendly methods should be used to grow plants vigorously in the campus which could reduce the environmental pollution. Use of biofertilizers, organic manures (cow dung, vermicompost and plant wastes and litters) and green manures to grow healthy plants in the medicinal plant garden, kitchen garden and terrace garden should be ensured to keep the campus organic. The plant waste such as fallen leaves, stems, fruits, nuts, seeds and other plant parts should be used to make green manures. A



concrete or ground level green manure production unit and vermicomposting units will help to convert all the plant and animal based wastes into green/organic manures. This will be a healthy way of solid litter waste management in the campus. Minimal use of chemical fertilizers as part of integrated nutrient management system is acceptable but nil use of chemical fertilizers is highly appreciable and also helps to keep the campus more of an organic ecosystem. The soil, air, water and sunlight are the four major natural resources any campus gets. Proper use and conservation of these resources are mandatory in green campus audit sites. The available resources and their utilization should be accounted for from time to time. Management of the right way of utilization of these resources with the vision of sustainability should be carried out by framing a committee led by the Head of the Institution concerned. Biofertilizers such as Nitrogen fixing bacteria, Potassium and Phosphorus solubilizing bacteria, Potassium mobilizing fungi (VAM), farm yard manure, dried cow dung manure, vermicompost manures and biofungicides and biopesticides are extensively used in the AIT to cultivate plants. Agrochemicals, chemical fertilizers (urea, murate of potash, sulphate of potash, rock phosphate, etc.), pesticides and fungicides are not used. These practices are very well appreciated because air, water and soil pollution due to use of agrochemicals is eradicated which in turn to improve the soil health significantly.

### 13.14. Conduct of Outreach programmes for dissemination of Green Campus motto and Green pledge initiatives by Eco club, Nature club, Associations, Cells, Forums, NCC/Student Force and NSS bodies in Green Campus initiatives

Professional implementation of all the Eco plans in the campus should be done through the Eco clubs, Nature clubs, Science clubs, Youth Red cross units, Fine Arts clubs, Women cell, Associations, Forums, SSL, NCC (National Cadet Corps) and NSS (National Service Scheme). All the students, members of staff and employers should be mandatory members of the club and should do tree planting and maintenance of greenery in the campus periodically. Conducting frequent seminars, conferences, workshops, awareness rallies, etc. on



topics relevant to the environment is necessary to educate and create awareness among the students and staff members. In addition, student's associations, cells, clubs and forums should be the first hand receivers of all the new plans proposed by the Government such as Swachh Bharath Abhiyan and Jal Shakti Abhiyan under

Clean India Mission and implement the same in the campus. The AIT has well developed, NSS, Swatch Bharath Abhiyan under Clean India Mission. These bodies are actively involved in mass cleaning programme across Hosur municipality. The AIT is conducting a large number of activities to conserve the nature and to teach about the importance of environment to rural, tribal and urban people.

Awareness programmes on the green campus initiatives and dissemination of green motto and pledges are accounted in a sustainable manner. Its benefits and self-sustainability are being 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. Technology driven solutions initiated by the green campus organization are periodically disseminated and documented successively for propagating the attitude of the green campus in wider masses. The AIT has taken sufficient attempts to disseminate the green campus motto and green pledge such as plastic carry bags eradication drive with Hosur municipal employees.

The AIT is implemented the 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 to people living in Hosur. These activities are very important in view of the instantaneous vicinity to undertake progressive programmes and conducted Participatory rural appraisal programmes. It is involving the socioeconomic position of the inhabitants, natural resources, traditional knowledge systems, cropping patterns, etc. of the rural and tribal people. The AIT is also focusing on the development of women through Women Empowerment cell. It provides awareness to overcome women exploitation and women entrepreneurs.

The AIT helps to develop social commitment and to expose the students to get sensitized to social realities and to build a link between the student community and the wider community. It initiated many soft skill training programmes to improve the skill set of the students. This has equipped them to face interviews, participate in group discussions with self-confidence and gain better placements.

### **13.15. Establishment of Aquarium and Aquatic plants**

Growing fishes in the small ponds will keep the environment pleasant. In the closed environment like corridors and the front offices, auditoriums and gallery classes placing the fish aquarium as well as plant aquarium will improve the scenic value of the place bringing peace to the people. The fish water waste also can be used as manure for growing potted indoor plants. Growing *Lotus*, *Lilly*, *Hydrilla* and other water plants will give a pleasant and calm environment and growing like *Guppies* can keep the water clean and neat. The fountains and small ponds can be built in the frontages to give an aesthetic look and also growing water plants in these ponds will help to maintain the aesthetic sense of the environment in greenish. The AIT campus has implemented a good aquatic ponds in which aquatic plants and birds will live generously.

### **13.16. Academic credentials: Projects, Dissertations and Thesis work**

Project, Dissertation and Thesis works are academic effort credentials that always fosters the innovative ideas on thinking and implementation of new innovative approaches. Applied research work of the faculties, staff and student 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. 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. The AIT faculty members and students from various subject domains are started a doing extensive project work related to nature conservation, environmental pollution, soil and water analysis.

### Celebrations of World Environment Day, Independence day and Republic day in AIT, Chikkamangaluru, Karnataka



## Campus cleaning programme in AIT, Chikkamagaluru, Karnataka



## Creating awareness programme on World Environment day By AIT, Chikkamagaluru, Karnataka



### 14. Best practices followed on Green Campus initiatives in the Organization

1. NSS activities at AIT conducted Medical Camp, , Blood Donation camp, Eye checkup Camp, Women Empowerment programme, Yoga Day Event, Swatch Bharat campaign Road Safety Programme, Awareness about Education to Government School Students and Planted the saplings in different places.
2. A well-established Rainwater harvesting system s to recharge ground water status by collecting rainwaters from the campus coinciding with the contour of the terrain and natural drains.
3. It is observed that the AIT is maintaining more than 70% of the green cover area after building construction as per the guidelines of World Green Building Council and Indian Green Building Council to provide a healthy environment and ecofriendly atmosphere to the stakeholders. It is calculated that the natural vegetation was 45 %and planted vegetation was 55%.

4. The AIT campus is established in Chikkamagaluru, Karnataka, India which provide pure atmosphere to the stakeholders under natural environment, topology, landscape and soil erosion. The campus is established without disturbing the natural vegetation along with the artificially created topography like pathways and parking areas.
5. In view of floral biodiversity in the AIT campus, a sum 123 species belonging to 72 Genera under 52 families covering trees, herbs, shrubs, climbers, lianas, twiners and lawns and 6 species belonging to Lichens, Pteridophytes, Bryophytes and Mycoflora like Mushrooms were recorded. It is observed that all the plants are growing profusely and showing healthier free from pests and diseases.
6. In view of faunal biodiversity in the AIT campus, a total of 6 living Mammals representing six Genera under six families, visiting Mammal species (3) belonging to three Genera under three families, 15 species of birds, 6 species of Grasshopper, 4 species of Termites, 8 species of Amphibians, 6 species of Reptiles, 13 species of Butterflies and Three species Mosquitos were recorded and documented.
7. The AIT has established rainwater harvesting models, percolation pond to recharge the borewells by collecting rainwaters from the building roofs, open areas and playgrounds including unexplored areas which are channelized to flow of rainwaters to increase the ground water level.
8. The campus has a maximum number of more oxygen releasing and carbon dioxide assimilating plants such as *Azadirachta indica*, *Eucalyptus globosus*, *Syzygium cumini*, *Terminalia arjuna*, *Ficus religiosa*, *Polyalthia longifolia*, *Ficus benghalensis*, *Minusops elengi*, *Murraya koenigii*, *Mangifera indica* and *Tectona grandis*.

## 15. Recommendations for Greening

- The name board may be kept in each plant species in which the common name along with binomial name may be mentioned. The year of planting and economic importance with medicinal values if any may be mentioned in some plants so that the oldest as well as useful herbal plants may be identified in the campus.
- A well-established Biogas plant for energy efficiency management and to reduce the fossil fuel expenditure as well as impact on the environment may be created. The treated effluent from biogas plant may be diverted to the STP for storage and utilized for irrigation purpose.
- Honey Bee hives may be kept in the campus which is free from student's mobilization. Honeybees are natural pollinators help to increase the yield potential of plants (flowers, fruits and vegetables) upto 33%.
- Automatic water irrigation systems like drip and sprinkler irrigation methods adopted may be extended in the entire green area of the campus which in turn are useful to reduce the operation costs under energy conservation policy.
- To ensure Miyawaki Forest system, one student one plant concern to enrich the campus Green which provide an ecofriendly campus to the stakeholders.

## 16. Conclusion

The Adichunchanagiri Institute of Technology (AIT) is affiliated to Visvesvaraya Technological University, Belagavi and Recognized by All India Council for Technical Education, New Delhi. The AIT is to cater the needs of the nation in the development of technocrats and to provide facilities for educating and training men and women to meet the entrepreneurial and management needs. The management has created adequate infrastructural facilities and sufficient funds and is keen on developing the institution for higher education. The Organization has taken enormous efforts to maintain green campus to the students, research scholars, staff members and parents in a sustainable manner which reflects the importance of the environment and stakeholders. It is conducting a large number of activities for the benefit of rural and tribal community people without disturbing the natural environment, topology, landscape management and vegetation. The AIT Campus is maintaining more than 70% of the green cover area after building construction along with the natural vegetation was 45 % and planted vegetation was 55%.

The natural topography and very good landscape design without disturbing the natural vegetation are being maintained by the AIT. A maximum number of more oxygen releasing and carbon dioxide assimilating plants are being maintained to provide pure atmosphere to the stakeholders. The installation of a rainwater harvesting system, percolation ponds and drip irrigation system to conserve rainwater and ground water are noteworthy in the campus. The Organization has created medicinal, herbal and ornamental gardens at small scale level for establishing a massive reforestation / afforestation planting programme in which a large number of trees and shrubs species were planted together for providing an eco-friendly atmosphere to the stakeholders in a sustainable manner.

## 17. Acknowledgement

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## Methodology for Flora and Fauna Identification

### I. Identification of Flowering Plant Species

Various vascular plant species were identified based on the following identification key by adopting the polyphasic taxonomic approach

#### Key to Plant Families Identification

1a. Seeds enclosed in fruit wall, Perianth Present.....	2
b. Seeds not enclosed in fruit wall, perianth absent.....	Gymnosperm
2a. Leaves usually net veined seeds-2.....	3
b. Leaves parallel veined, seeds-1.....	66
3a. Petals free.....	4
b. petals connate.....	41
4a. Corolla and calyx present.....	5
b. Corolla and calyx absent.....	24
5a. calyx of united sepals; ovary inferior.....	31
b. Calyx of distinct or unit sepals; ovary syncarpous.....	6
6a. Sepals imbricate in bud.....	7
b. Sepals valvate in bud.....	24
7a. Sepals more or less united at the base.....	19
b. Sepals free.....	8
8a. Stamens more than 12.....	9
b. Stamens 10 or fewer.....	13
9a. Sepals 2-3.....	11
b. Sepals 4 or more.....	10
10a. Stamens inserted on the disk.....	Cleomaceae
b. Stamens inserted of the gynophore.....	Capparaceae
11a. Trees, Petals more or like the sepals; carpels free.....	Magnoliaceae
b. Herbs, petals coloured unlike the sepals; carpels united.....	12
12a. Plants with yellow sap, Flowers pedicelled.....	Papaveraceae
b. Plants with watery sap, Flowers sessile.....	Portulacaceae
13a. Flowers unisexual, gynoecium apocarpous.....	Menispermaceae
b. Flowers bisexual, gynoecium Syncarpous.....	14
14a. Petals 4, Stamens 6.....	Brassicaceae
b. Petals 5, Stamens $\infty$ .....	15
15a. Ovary 1, loculated.....	16
b. Ovary 2-more loculated.....	17
16a. Flowers actinomorphic, placentas free- central.....	Caryophyllaceae
b. Flowers zygomorphic, placentas parietal.....	Viloiaceae
17a. Filaments of anthers more or less united.....	Polygalaceae
b. Filaments of anthers more or less united.....	1
18a. Leaves stipulate; stamens 5 or 10.....	19
b. Leaves exstipulate; stamens usually 8.....	Sapindaceae
19a. Style 5; stamen 5.....	Oxalidaceae
b. Style many; stamens 10.....	Zygophyllaceae
20a. Leaves pellucid-gland dotted.....	Rutaceae

b. Leaves not gland dotted .....	21
21a. Placentas parietal; Fruit elongated .....	Moringaceae
b. Placentas axile; Fruits not elongated .....	22
22a. Ovules and seeds pendulous; sometimes horizontal.....	Meliaceae
b. Ovules and seeds erect or ascending .....	23
23a. Stamens alternate with the petals .....	Anacardiaceae
b. Stamens opposite the petals .....	Vitaceae
24a. Leaves simple; Flowers 3-merous. . . . .	Annonaceae
b. Leaves compound; Flowers 4-6 merous .....	25
25a. Filaments of anther united into a columnar toothed cup. . . . .	26
b. Filaments of anther free; rarely connate at the base in ring.....	28
26a. Stamens 15; anther united .....	Sterculiaceae
b. Stamens 2; anther free. . . . .	27
27a. Anther unilocular; pollen muricate .....	Malvaceae
b. Anther bilocular; pollen smooth .....	Bombacaceae
28a. Stamens 4-5; usually embraced and adnate to the base of the petal. . . . .	29
b. Stamen many; atleast twice as many as and free from the petals.....	30
29a. Shrub .....	Lythraceae
b. Straggler.....	Rhamnaceae
30a. Anther dehisce by slits; fruits capsule .....	Tiliaceae
b. Anther dehisce by spores; fruits drupe.....	Elaeocarpaceae
31a. Ovary syncarpous; placentas 3-5, parietal.....	32
b. Ovary 1 or more free, placentas basal .....	33
32a. Climbing herbs tendril .....	Passifloraceae
b. Erect shrubs or trees with tendril .....	Turneraceae
33a. Ovules arising from the inner angles or from base of the carpels or loculi .....	34
b. Ovules pendulous form the apex of the carpels or locules. . . . .	Combretaceae
34a. Carpels solitary; fruits legume. . . . .	35
b. Carpels more than 1; fruits otherwise. . . . .	37
35a. Flowers zygomorphic; petals imbricate. . . . .	36
b. Flowers actinomorphic; petals valvate. . . . .	Mimosaceae
36a. Upper petals outermost stamens monodelphous or diadelphous. . . . .	Fabaceae
b. Upper petals innermost stamens always free.....	Caesalpinaceae
37a. Flowers unisexual .....	Cucurbitaceae
b. Flowers bisexual.....	38
38a. Ovary 1-celled.....	Cactaceae
b. Ovary more than 1 celled. . . . .	39
39a. Carpels free if ultimately united the styles distinct. . . . .	40
b. Carpels and styles united throughout. . . . .	Myrtaceae
40a. Flowers in dichasial – polychasial cyme. . . . .	Molluginaceae
b. Flowers in clustered, cymes or solitary .....	Aizoaceae
41a. Ovary inferior, stamens as many as the corolla lobes. . . . .	42
b. Ovary superior, stamens numerous .....	43
42a. Anther free; ovary 2-loculed; stipulate. . . . .	Rubiaceae
b. Anther syngenesious; ovary 1-loculed, exstipulate. . . . .	Asteraceae
43a. Ovary 1-loculed; placentation free central.....	Plumbaginaceae
b. Ovary 2-many loculed; placentation axile or parietal .....	44
44a. Ovary 3 or more carpelled. . . . .	Sapotaceae
b. Ovary 2-carpelled.....	45

45a. Corolla actinomorphic.....	46
b. Corolla zygomorphic.....	50
46a. Plants leafless; parasitic... ..	Cuscutaceae
b. Plants leafy ; not parasitic.....	47
47a. Leaves opposite; stamens 2.....	- 48
b. Leaves alternate; stamens 4 or more.....	49
48a. Leaves not scabrid, corolla tube white: fruits berry .....	Oleaceae
b. Leaves scabrid; corolla tube orange; fruits capsules .....	Nyctanthaceae
49.a. Anther inseperatable; corona present .....	Asclepidiaceae
b. Anther seperatable; corona absent .....	Apocyanaceae
50a. Corolla lobes imbricate ;fruit drupe .....	Boraginaceae
b. Corolla lobes plicate; fruit capsule .....	Convolvulaceae
51.a Ovary cells many ovulated.....	Solanaceae
b. Ovary cells 1-4 ovuled.....	52
52.a Carpels 2 or more ovulated ; fruits dehiscent .....	53
b. Carpels 1 –ovulated ; fruits indehiscent .....	57
53.a Fruits dehiscent; seeds supported on reticulae... ..	Acanthaceae
b. Fruits indehiscent; seeds not supported on reticulae... ..	54
54.a. Leaves compound; fruits elongated; seeds winged .....	Bignoniaceae
b. Leaves simple;fruits not elongated, seeds not winged... ..	55
55.a. Ovules many on swollen placentas; seeds albuminous .....	Scropulariaceae
b. Ovules 2 lobed placenta ; seeds not albuminous... ..	56
56.a Flowers solitary; axile placentation .....	Pedaliaceae
b. Flowers raceme; axile placentation .....	Marytiniaceae
57.a Ovary entire, style terminal.....	Verbinaceae
b. Ovary 4 –lobed, style gynobasic.....	Lamiaceae
58.a Flower bisexual.....	59
b. Flower unisexual .....	62
59.a. Ovary inferior.....	60
b. Ovary superior .....	61
60.a Ovary 4-6 loculated; ovules many.....	Aristolochiaceae
b. Ovary 1-loculated; ovules 1-4.....	Santalaceae
61.a Perianth not tubular .....	Amarathaceae
b. Perianth trubular .....	Nyctaginaceae
62a. Leafless trees; brachlets ribbed and joined at the nodes... ..	Casuarinaceae
b. Leaves well developed ; brachlets not ribbed and not joined at the nodes.....	63
63 a. Ovary 1- loculed; ovules 1-2 in each loule.....	64
b. Ovary 2 or more loculed;ovules 1 or 2 in each locule... ..	65
64a. Leaves glandular... ..	Euphorbiaceae
b. Leaves eglandular... ..	Urticaceae
65a. Filaments inflexed in bud with reversed anther... ..	Moraceae
b. Filaments not inflexed in bud, not with reversed anther.....	Ulmaceae
66a. Terrestrial or epiphytic... ..	67
b. Aquatic, marsh or riparian .....	Cyperaceae
67a. Arbrorescent woody; leaf blade many nerved articulate with sheath. Bambusaceae	
b. Herbs with herbaceous culms; leaf blade sessile not articulate with sheath... ..	68
68a. Perianth 0 or reduced to scale... ..	Araceae
b. Perianth present.....	69
70a. Plant armed... ..	71
b. Plant unarmed... ..	72

- 71a. Plants Xerophytic; leaves fibrous... Agavaceae  
 b. Plants not xerophytic; leaves nor fibrous... Liliaceae  
 72 a. Perianth segments connate... Amaryllidaceae  
 b. Perianth segments free... 73  
 73a. Outer perianth calycine; inner coroline... Commelinaceae  
 b. Outer and inner perianth... 74

## II. Identification of Non-Flowering Plant Species

Lichen samples were identified based morphological, biochemical and anatomical features and representative samples were compared with the voucher specimens at the Lichen Herbarium Centre of National Botanical Research Institute (NBRI), Lucknow, Uttar Pradesh, India.

### Key to identify the Lichen Genera

#### Key to Genera

- 1 a. Photobiont cyanobacteri urn..... *Leptogium cyanascens*.  
 1 b. Photobiont green alga.....2  
 2. Thallus leprose, crustose.....Group I  
 3. Thallus foliose... Group II  
 4. Thallus fruticose.....Group III

#### Group I

- 1 a. Thallus leprose, ..... *Chrysothrix chlorina*  
 1 b. Thallus crustose. .... *Graphis* sp

#### Group II

- 1 a. Lower side of thallus pseudocyphellae, photobiont Nostoc ..... *Pseudocyphellaria*  
 1 b. Thallus lacking pseudocyphellae  
 2.a. Upper cortex thick walled longitudinally oriented, conglutinate hyphae... 3  
 2 b. Upper cortex otheriwse... 4  
 3 a. Thallus lower side canaliculated zeorin, norstictic and salazinic acids, and unknown pigments and triterpenoids present... *Heterodermia leucomelos*  
 3 b. Thallus lower side no canaliculated only in medulla.... *Heterodermia diademata*  
 4 a. Cilia bulbate at the base, thallus grey to grey brown ..... *Bulbothrix*  
 4 b. Cilia present or absent, not bulbate..... 5  
 5 a. Rhizines dichotomously branched present throughout the margins. .. *Hypotrachyna*  
 5 b. Rhizines restricted to center of lower surface, margin bare, smooth shining..... 6  
 6 a. Lobes narrow, long, dichotomously branched, canaliculate..... *Everniastrum*  
 6 b. Lobes otherwise. .... 7  
 7 a. Lobe margins ciliate..... 8  
 7 b. Lobe margins eciliate..... 9  
 8 a. Salazinic acid present K+ Red cortex..... 10  
 8 b. Salazinic acid absent..... 11  
 9 a. Thallus with is idia... *Parmotrema tinctorum*  
 9.b Thallus with soredia... 12  
 10 a. thallus emaculate... *P.stuppeum*  
 10 b. thallus maculate... *P.reticulatum*  
 11 a. Protolichesternic acid in medulla..... *P.grayanam*  
 11 b. Alectoronic acid in medulla..... *P. nilgherrense*  
 12 a. Thallus large lobed, loosely attached, mainly corticolous..... *P. austrosinense*  
 12 b. Thallus smaller, closely to strongly attached, saxicolous..... *P.defectum*

**Group III**

- 1 a. Squamules in thallus ..... *Cladonia* sp  
 1 b. Squamules absent in thallus.....2  
 2 a. Thallus flat, strap shaped or palmately lobed. .... *Ramalina*  
 2 b. Thallus round to angular in section .....3  
 3 a. Thallus bright yellow to orange, K+ purple. .... *Teloschistes*  
 3 b. Thallus greenish grey or yellowish grey pendent or erect.....4  
 4 a. Medulla K+ red Stictic acid present ..... *Usnea stigmatoides*  
 4 b. Medulla K- norstictic psoromic acid present ..... *Usnea dasaea*

**III. Identificayion of Algae Genera**

Algae identification key consists of couplets of characteristics using algal description of the specimen based on morphological characterization from 58 Genera to species level identification as per the comprehensive key.

**Key to identify the Algae species**

- 1A. Plant pigments contained in chromatophores or chloroplasts----- 10  
 1B. Plant pigments not contained, but diffused through protoplast ----- 2  
 2A. Plants filamentous; cells arranged in trichomes ----- 4  
 2B. Plants colonial, not filamentous .....3  
 3A. Cells in regular rows, in multiples of four; ----- *Agmenellum*  
 3B. Cells somewhat evenly arranged toward periphery of spherical colony; barely visible gelatinous strands radiate from center of colony to cells *Gomphosphaeria*  
 3C. Colony asymmetrical; cells very dense and unevenly distributed ----- *Anacystis*  
 4A. Filaments straight or slightly flexed.....6  
 4B. Filaments curved, twisted, or spiralled ----- 5  
 5A. Heterocysts and akinetes present ----- *Anabaena*  
 5B. Heterocysts absent ..... *Raphidiopsis*  
 6A. Heterocysts present.....9  
 6B. Heterocysts absent .....7  
 7A. Filaments without a sheath; cells discoid ----- *Oscillatoria*  
 7B. Filaments with distinct sheath .....8  
 8A. Trichomes tangled; sheaths confluent ----- *Phormidiwn*  
 8B. Trichomes separate; sheaths not confluent ----- *Lyngbya*  
 9A. Heterocysts terminal ----- *Cylindrospermum*  
 9B. Heterocysts intercalary ----- *Ahphanizomenon*  
 10A. Cell walls without punctae or striae----- 31  
 10B. Cell walls rigid, ornamented with punctae or striae----- 11  
 11A. Frustules adiametric, two or more times longer than wide, elongate----- 15  
 11B. Frustules isodiametric, generally shorter in length than in diameter, round or elliptical or ovoid or nearly so ..... 12  
 12A. Frustules elliptical or ovoid or nearly so ----- 14  
 12B. Frustules discoid or nearly so ..... 13  
 13A. Valves radially punctate ----- *Stephanodiscus*  
 13B. Valves with two concentric regions, the inner being smooth----- *Cydotella*  
 14A. Frustules with marginal keel containing a raphe ----- *Surirella*  
 14B. Frustules with a pseudoraphe or with a raphe not in a marginal keel--- *Cocconeis*  
 15A. Frustules cylindrical arranged end to end into filament ----- *Melosira*  
 15B. Frustules not arranged into filaments ----- 16  
 16A. Frustules with a raphe in at least one valve ----- 21  
 16B. Frustules without a raphe in either valve, pseudoraphe evident----- 17

17A. Frustules united in zigzag chains -----	<i>Tabellaria</i>
17B. Frustules not in zigzag chains -----	<i>Pseudoraphe</i>
18A. Frustules united laterally -----	<i>Fragilaria</i>
18B. Frustules not united laterally -----	19
19A. Frustules united apically forming spokelike colony -----	<i>Asterionella</i>
19B. Frustules not forming spokelike colony -----	20
20A. Frustules needle shaped without costae -----	<i>Synedra</i>
20B. Frustules with prominent costae -----	<i>Diatom</i>
21A. Frustules sigmoid or "S" shaped -----	<i>Gyrosigma</i>
21B. Frustules not sigmoid -----	22
22A. Frustules longitudinally symmetrical, other than lunate in valve view -----	25
22B. Frustules with raphe in both valves, longitudinally asymmetrical, lunate -----	23
23A. Valves with transverse costae -----	<i>Epithemia</i>
23B. Valves without transverse costae -----	24
24A. Raphe a smooth curve with well defined central and polar nodules -----	<i>Cymbella</i>
24B. Raphe not a smooth curve, gibbose with marginal central nodule -----	<i>Amphora</i>
25A. Frustules with raphe in both valves -----	27
25B. Frustules with pseudoraphe in one valve and raphe in other valve -----	26
26A. Frustules wedge-shaped in girdle view and cuneate in valve -----	<i>Rhoicosphenia</i>
26B. Frustules shaped otherwise -----	<i>Achnanthes</i>
27A. Raphe extended length of valve; polar nodules; central nodules lacking -----	<i>Eunotia</i>
27B. Raphe restricted to polar regions -----	28
28A. Raphe located in a canal -----	<i>Nitzschia</i>
28B. Raphe not located in a canal -----	29
29A. Frustules with symmetrical valves -----	30
29B. Frustules with valves symmetrical but asymmetrical -----	<i>Gomphonema</i>
30A. Valves with transverse costae -----	<i>Pinnularia</i>
30B. Valves with transverse punctae -----	<i>Navicula</i>
31A. Cells solitary -----	45
31B. Cells colonial or grouped -----	32
32A. Cells enclosed in conical to cylindrical lorica; joined lorica have treelike appearance -----	<i>Dinobryon</i>
32B. Cells and lorica without treelike appearance -----	33
33A. Colony discoid, one cell in thickness; cells in concentric rings -----	<i>Pediastrum</i>
33B. Colony not discoid -----	34
34A. Colonies spherical or globose -----	40
34B. Colonies not spherical -----	35
35A. Colony with elongate cells radiating from common center -----	<i>Actinastrum</i>
35B. Colony with cells not radiating from common center -----	36
36A. Colony with four to eight cells positioned in linear series -----	<i>Scenedesmus</i>
36B. Colony with cells not in linear series -----	37
37A. Colony with arcuate to lunate cells with apices acutely -----	<i>Selenastrum</i>
37B. Colony with spherical to broadly ellipsoidal cells -----	38
38A. Cells without spines or setae -----	<i>Crucigenia</i>
38B. Cells with spines or setae -----	39
39A. Cells quadrate, closely apposed; free face of each cell with spines -----	<i>Tetrastrum</i>
39B. Cells quadrate and united; free face cell with long delicate setae -----	<i>Micractinium</i>
40A. Colony with biflagellated cells -----	<i>Pandorina</i>
40B. Colony with nonflagellated cells -----	41
41A. Cells lunate to sickle shaped -----	<i>Kirchneriella</i>



41B. Cells spherical or nearly so .....	42
42A. Cells borne terminally on dichotomously branched threads ----- <i>Dictyosphaerium</i>	
42B. Cells not on dichotomously branched threads .....	43
43A. Colony a hollow sphere .....	<i>Coelastrum</i>
43B. Colony not a hollow sphere .....	44
44A. Colony surrounded by gelatinized and expanded parent cell wall .....	<i>Oocystis</i>
44B. Colony with cells equidistant and toward periphery .....	<i>Sphaerocystis</i>
45A. Cells with median constriction dividing cell into two distinct halves ----- <i>Cosmarium</i>	
45B. Cells without pronounced median constriction .....	46
46A. Cells nonflagellated .....	53
46B. Cells flagellated .....	47
47A. Cell walls without polygonal plates .....	49
47B. Cell walls with polygonal plates .....	48
48A. Cells walls of thick plates with distinct sutures .....	<i>Peridinium</i>
48B. Cells walls with faintly distinct plates and sutures .....	<i>Glenodinium</i>
49A. Cells uniflagellate .....	52
49B. Cells biflagellate .....	50
50A. Cells with two flagella of equal length .....	<i>Chlamydomonas</i>
50B. Cells with two flagella of unequal length .....	51
51A. Cells with single chromatophore .....	<i>Chroomonas</i>
51B. Cells with 2 large chromatophores .....	<i>Cryptomonas</i>
52A. Cells surrounded by distinct lorica .....	<i>Trachelomonas</i>
52B. Cells without lorica; fusiform to acicular shaped; posterior end .....	<i>Euglena</i>
53A. Cells acicular to fusiform with ends tapering into long spines .....	<i>Schroederia</i>
53B. Cells without ends tapering into long spines .....	54
54A. Cells without setae .....	56
54B. Cells with setae .....	55
55A. Cells with subpolar or both subpolar and equatorial long setae .....	<i>Chodatella</i>
55B. Cells with multiple peripheral long delicate setae .....	<i>Golenkinia</i>
56A. Cells long, slender, and tapered at both ends .....	<i>Ankistrodesmus</i>
56B. Cells flattened or isodiametric, triangular, quadrangular .....	<i>Tetraedron</i>

#### IV. Identification of Major Groups of Mushrooms

Mushrooms are belonging to fungal kingdom which are edible and non-edible in nature. They represented in various colours starting from white, black, brown, red and pale yellow rot fungi. They are identified based on the following characterization key

##### Key to identify the Mushrooms species

1. Mushroom growing on other mushrooms or the decayed remains ----- *Mycotrophs*
2. Growing shelflike on wood (or, if not, then gills *concentric* rather than radial); mushroom *very* tough and leathery, corky, or woody (try tearing it in half); gills tough and hard, sometimes maze-like; cap frequently (but not always) with concentric zones of colour .....
 *Polypores* |
3. Gills running down the stem, not platelike and thus not easily separable from the cap and stem (try removing an entire "gill" with your fingers or a sharp object); mushroom usually *not* growing on wood .....
 *Chanterelles and Trumpets* |
4. Gills not as above; mushroom growing on wood or elsewhere ---- *Gilled Mushrooms*
5. Stem absent--or, if present, lateral, Flesh in stem tough .....
 *Polypores* |
6. Raphe a smooth curve with well defined central and polar nodules .....
 *Cymbella* |
7. Raphe not a smooth curve, gibbose with marginal central nodule .....
 *Amphora* |
8. Frustules with raphe in both valves .....
 27 |

9. Frustules with pseudoraphe in one valve and raphe in other valve-----	26
10. Colony with cells not radiating from common center -----	36
11. Colony with four to eight cells positioned in linear series -----	<i>Scenedesmus</i>
12. Colony with cells not in linear series -----	37
13. Colony with arcuate to lunate cells with apices acutely-----	<i>Selenastrum</i>
14. Cells acicular to fusiform with ends tapering into long spines -----	<i>Schroederia</i>
15. Cells without ends tapering into long spines-----	54
16. Cells without setae.....	56
17. Cells with setae .....	55
18 Cells with subpolar or both subpolar and equatorial long setae-----	<i>Chodatella</i>
19. Raphe extended length of valve; polar nodules; central nodules lacking ----	<i>Eunotia</i>
20. Raphe restricted to polar regions.....	28
21. Raphe located in a canal.....	<i>Nitzschia</i>
22. Filaments with distinct sheath .....	8
23. Trichomes tangled; sheaths confluent .....	<i>Phormidium</i>
24. Trichomes separate; sheaths not confluent-----	<i>Lyngbya</i>
25. Heterocysts terminal .....	<i>Cylindrospermum</i>
26. Heterocysts intercalary .....	<i>Aphanizomenon</i>
27. Cell walls without punctae or striae.....	31
28. Cell walls rigid, ornamented with punctae or striae-----	11
29. Frustules adiametric, two or more times longer than wide, elongate-----	15
30. Frustules isodiametric, generally shorter than round or elliptical or ovoid -----	12
31. Frustules elliptical or ovoid or nearly so .....	14
32. Frustules discoid or nearly so.....	13
33. Valves radially punctate .....	<i>Stephanodiscus</i>
34. Valves with two concentric regions, the inner being smooth-----	<i>Cydotella</i>
35. Frustules with marginal keel containing a raphe .....	<i>Surirella</i>
36. Frustules with a pseudoraphe or with a raphe not in a marginal keel ----	<i>Cocconeis</i>
37. Cap round in outline; pore surface not running down the stem, or only slightly running down the stem; spore print not white-----	<i>Boletes</i>
38. Mushroom with spines or "teeth"--either on the underside of a cap, or hanging from a branched structure, or clumped in an indistinct mass .....	<i>Toothed Mushrooms</i>
39. Mushroom covered in some part with a foul-smelling slime; arising from a soft underground "egg"; variously shaped (like a club or stick, like crab claws, like a lantern, like a Wiffle ball, etc.); frequently found in woods .....	<i>Stinkhorns</i>
40. Mushroom more or less shaped like a ball, or like a ball raised up on a stem, or like a ball set on a starfish.....	<i>Puffballs</i>
41. Cap shape convex to centrally depressed or vase-shaped; undersurface, smooth, wrinkled, or gill-like; fruiting embedded-----	<i>Chanterelles</i>
42. Cap shape oval, pointed, lobed, saddle-shaped, irregular, or thimble-like (never vase-shaped or convex); undersurface absent, or hard to see or define; many (but definitely not all) species fruiting .....	<i>Trumpets</i>
43. Stem completely hollow, or hollow with cottony fibers inside; cap with pits and ridges, or longitudinally wrinkled, or fairly smooth (never lobed or convoluted); without reddish or reddish brown shades; found in spring .....	<i>Morels &amp; Verpas</i>
44. Found in summer and fall (or spring in warm coastal areas); cap lobed, saddle-shaped, or irregular and whitish, greyish, brownish, or black; stem surface ribbed or "pocketed" in some species .....	<i>Saddles</i>
45. Found in summer and fall (or spring in warm coastal areas); cap lobed, saddle-shaped, or irregular and whitish, greyish, brownish, or black-----	<i>Oddballs &amp; Misfits</i>

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### **NATURE SCIENCE FOUNDATION**

**LIG II, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004,  
TAMILNADU, INDIA.**

has been independently assessed by QRO  
and is compliant with the requirement of:

**ISO 50001:2018**

### **Energy Management Systems**

For the following scope of activities:

PROVIDING CONSULTANCY SERVICES FOR ENVIRONMENT, ENERGY, GREEN, HYGIENE, SOIL AND WATER, WASTE MANAGEMENT, BIOMEDICAL WASTE MANAGEMENT, E-WASTE MANAGEMENT, PLASTIC WASTE MANAGEMENT AND ACADEMIC AND ADMINISTRATIVE AUDITS TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS AS PER THE OWN CHECKLISTS, START UP THE INTERNATIONAL ECO CLUB STUDENTS CHAPTER, OFFERING LEAD AUDITOR COURSE ON ENERGY AND ENVIRONMENT, AWARDS TO MERITORIOUS CANDIDATES.

Date of Certification: 9th August 2022

2<sup>nd</sup> Surveillance Audit Due: 8th August 2024

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

Certificate Expiry: 8th August 2025

**Certificate Number: 305022080903EN**



*Chunankar..*

Head of Certification

Validity of this certificate is subject to annual surveillance audits to be done successfully on or before 365 days from date of the audit.

(In case surveillance audit is not allowed to be conducted; this certificate shall be suspended / withdrawn).

**The Validity of this certificate can be verified at [www.qrocet.org](http://www.qrocet.org)**

This certificate of registration remains the property of QRO Certification LLP, and shall be returned immediately upon request.

**India Office : QRO Certification LLP**

142, IInd Floor, Avtar Enclave, Near Paschim Vihar West Metro Station, Delhi-110063, (INDIA)

Website : [www.qrocet.org](http://www.qrocet.org), E-mail : [info@qrocet.org](mailto:info@qrocet.org)

UDYAM REGISTRATION NUMBER		UDYAM-TN-03-0073706																					
NAME OF ENTERPRISE		M/S NATURE SCIENCE FOUNDATION																					
TYPE OF ENTERPRISE *		MICRO																					
MAJOR ACTIVITY		SERVICES																					
SOCIAL CATEGORY OF ENTREPRENEUR		GENERAL																					
NAME OF UNIT(S)		<table border="1"> <thead> <tr> <th>S.No.</th> <th>Name of Unit(s)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Green Campus, Energy and Environment Management Audits</td> </tr> </tbody> </table>		S.No.	Name of Unit(s)	1	Green Campus, Energy and Environment Management Audits																
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OFFICIAL ADDRESS OF ENTERPRISE		<table border="1"> <thead> <tr> <th>Flat/Door/Block No.</th> <th>LIG-II,2669</th> <th>Name of Premises/ Building</th> <th>GANDHIMAA NAGAR</th> </tr> </thead> <tbody> <tr> <td>Village/Town</td> <td>Gandhinagar S.O</td> <td>Block</td> <td>LIG-II</td> </tr> <tr> <td>Road/Street/Lane</td> <td>Poolamedu</td> <td>City</td> <td>Coimbatore South</td> </tr> <tr> <td>State</td> <td>TAMIL NADU</td> <td>District</td> <td>COIMBATORE , Pin 641004</td> </tr> <tr> <td>Mobile</td> <td>956677255</td> <td>Email:</td> <td>chairmannsf@gmail.com</td> </tr> </tbody> </table>		Flat/Door/Block No.	LIG-II,2669	Name of Premises/ Building	GANDHIMAA NAGAR	Village/Town	Gandhinagar S.O	Block	LIG-II	Road/Street/Lane	Poolamedu	City	Coimbatore South	State	TAMIL NADU	District	COIMBATORE , Pin 641004	Mobile	956677255	Email:	chairmannsf@gmail.com
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State	TAMIL NADU	District	COIMBATORE , Pin 641004																				
Mobile	956677255	Email:	chairmannsf@gmail.com																				
DATE OF INCORPORATION / REGISTRATION OF ENTERPRISE		28/11/2017																					
DATE OF COMMENCEMENT OF PRODUCTION/BUSINESS		12/03/2020																					
NATIONAL INDUSTRY CLASSIFICATION CODE(S)		<table border="1"> <thead> <tr> <th>S.No.</th> <th>NIC 2 Digit</th> <th>NIC 4 Digit</th> <th>NIC 5 Digit</th> <th>Activity</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>69 - Legal and accounting activities</td> <td>6920 - Accounting, bookkeeping and auditing activities; tax consultancy</td> <td>69201 - Accounting, bookkeeping and auditing activities</td> <td>Services</td> </tr> <tr> <td>2</td> <td>85 - Education</td> <td>8542 - Cultural education</td> <td>85420 - Cultural education</td> <td>Services</td> </tr> <tr> <td>3</td> <td>85 - Education</td> <td>8549 - Other education n.e.c.</td> <td>85499 - Other educational services n.e.c.</td> <td>Services</td> </tr> </tbody> </table>		S.No.	NIC 2 Digit	NIC 4 Digit	NIC 5 Digit	Activity	1	69 - Legal and accounting activities	6920 - Accounting, bookkeeping and auditing activities; tax consultancy	69201 - Accounting, bookkeeping and auditing activities	Services	2	85 - Education	8542 - Cultural education	85420 - Cultural education	Services	3	85 - Education	8549 - Other education n.e.c.	85499 - Other educational services n.e.c.	Services
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DATE OF UDYAM REGISTRATION		26/02/2022																					

\* In case of graduation (upward/reverse) of status of an enterprise, the benefit of the Government Schemes will be availed as per the provisions of Notification No. S.O. 2119(E) dated 26.06.2020 issued by the Mo MSME.

Disclaimer: This is computer generated statement, no signature required. Printed from <https://udyamregistration.gov.in> & Date of printing: - 26/02/2022

For any assistance, you may contact:

1. District Industries Centre: COIMBATORE ( TAMIL NADU )

2. MSME-DI: CHENNAI ( TAMIL NADU )

Visit : [www.msme.gov.in](http://www.msme.gov.in) ; [www.dcmsme.gov.in](http://www.dcmsme.gov.in) ; [www.champions.gov.in](http://www.champions.gov.in)

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   NITI Aayog, Government of India

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# NGO DARPAN

In order to strengthen services of the portal, Government has decided to make PAN Number of VOs/NGOs mandatory.

Please Update Your Profile

Welcome, Nature Science Foundation

Your Unique Id: TN/2018/0187711



PROCEEDINGS OF THE COMMISSIONER OF INCOMETAX (EXEMPTIONS),  
III FLOOR, ANNEXE BLDG, NO.121, MAHATMA GANDHI SALAI, CHENNAI-34

Present : G.M.DOSS, I.R.S  
Commissioner of Income Tax (Exemptions)

\*\* URNo. AACTN7857J/05/18-19/T-1105

Dated:03/09/2018

Sub: Registration u/s. 12AA of the Income tax Act 1961 - in the case of

**“Nature Science Foundation”**  
LIG-II, 2669, Gandhima Nagar, Peelamedu, Coimbatore – 641 004.

Ref : Application in form 10 A filed on 28/03/2018

**ORDER UNDER SECTION 12AA OF THE INCOME TAX ACT 1961.**

1. The above Trust/Society/Association/ Company/ others/, bearing PAN AACTN7857J was constituted by Trust Deed / Memorandum of Association dated 29/11/2017 registered with Sub-Registrar's Office/ Registrar of Societies/Registrar of Companies/others on 29/11/2017.
2. ~~The Trust Deed / Memorandum of Association has subsequently been amended / modified / altered by a Codicil / Supplementary Deed / Amendment Deed / Alteration to Memorandum of Association/others dated XX/XX duly registered on XX/XX.~~
3. The above TRUST filed an application seeking Registration u/s 12 AA of the Income tax Act, 1961.
4. On going through the objects of the TRUST and its proposed activities as enumerated in the Trust Deed / Memorandum of Association, I am satisfied about the genuineness of the TRUST as on date.
5. The application has been entered at Sl.No.1105 maintained in this office. The above Trust is accordingly registered as a PUBLIC CHARITABLE TRUST u/s 12 AA of the Income Tax Act, 1961 with effect from 29/11/2017.
6. It is hereby clarified that the Registration so given to the Trust/Institution is not absolute. Subsequently, if it is found that the activities of the Trust/Institution are not genuine or are not being carried out in accordance with the objects and clauses of the Trust Deed / Memorandum of Association submitted at the time of registration or modified with the approval of the Commissioner of Income-tax (Exemptions), Chennai or there is a violation of the provisions of Section – 13, the Registration so granted shall be cancelled as provided u/s 12 AA (3) or 12AA(4) of the Income Tax Act. Further, this approval is also subject to the Trust/Society/Association/Company/ Others/ complying to the provisions of the proviso to sec 2(15) of the Income Tax Act 1961.
7. Granting of Registration u/s 12AA does not confer any automatic exemption of income from taxation. The Trust/Institution should conform to the parameters laid down in Sections 11, 12, 13 and 115 BBC of the I.T. Act, 1961, to claim exemption of its income on year to year basis before the Assessing Officer.

\*\* This Unique Registration No. URNo. AACTN7857J/05/18-19/T-1105 Should be mentioned in all your future correspondence.




Sd/-  
(G.M.DOSS, I.R.S)  
Commissioner of Income-tax(Exemptions), Chennai.

Copy to:

1. The Assessee.
2. The ACIT(Exemptions), Coimbatore Circle.
3. Office Copy.

//CERTIFIED TRUE COPY//

(N SRINIVASA RAO)  
Asst. Commissioner of Income-tax (H.Qrs)(Exemptions),  
Chennai.

  
 GOVERNMENT OF INDIA  
 INCOMETAX DEPARTMENT  
 OFFICE OF THE COMMISSIONER OF INCOME TAX (EXEMPTIONS)  
 Aayakar Bhawan, Annexe III Floor, 121 M.G. Road, Chennai 600 034

URNo. AACTN7857J/05/18-19/T-1105/80G

Date: 10.04.2019

Name of the Trust-/Society /Company/Institution : NATURE SCIENCE FOUNDATION  
 Address : LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004  
 PAN : AACTN7857J  
 Date of Application : 12.11.2018

Received  
 Rajiv S. Ponnappa  
 17/07/19

**APPROVAL UNDER SECTION 80G(5)(vi) OF THE INCOME TAX ACT, 1961**

The aforesaid Trust-/Society/Company/Institution has been registered u/s.12AA of the Income Tax Act with effect from 29.11.2017 vide AACTN7857J/05/18-19/T-1105 dated 03.09.2018. It is certified that donation made to NATURE SCIENCE FOUNDATION at LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004 shall qualify for deduction u/s 80G(5)(vi) of the Income Tax Act, 1961, subject to the fulfillment of conditions laid down in clauses [i] to [v] of sub-section (5) of section 80G of the I.T Act, 1961.

2. This approval shall be valid in perpetuity with effect from A.Y. 2019-20 unless specifically withdrawn. The details and validity of the certificate is available @ [office.incometaxindia.gov.in](http://office.incometaxindia.gov.in)
3. The Return of Income along with the Income & Expenditure Account, Receipts and Payments Account and Balance Sheet should be submitted annually to the Assessing Officer having jurisdiction over the case.
4. No change in the Trust Deed/Memorandum of Association shall be effected without the prior approval of the undersigned i.e. **Commissioner of Income Tax (Exemptions), Chennai**.
5. Every receipt issued to a donor shall bear the **Unique Registration Number** i.e. **URNo. AACTN7857J/05/18-19/T-1105/80G** and date of this order i.e. **10.04.2019**.
6. Under the provisions of section 80G(5)(i)(a), the institution/fund registered u/s.12A, u/s.12AA(1)(b) or approved u/s.10(23C), 10(23C)(vi)(via), etc., shall have to maintain separate books of accounts in respect of any business activity carried on and shall intimate this office within one month about commencement of such activity.

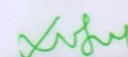


Sd/-  
 (G.M.DOSS, I.R.S)  
 Commissioner of Income Tax (Exemptions)  
 Chennai.

## Copy to:

1. The applicant
2. Guard File
3. The DCIT(Exemptions) Coimbatore Circle.

//Certified True Copy//

  
 (N. SRINIVASA RAO)  
 Assistant Commissioner of Income-tax (H.qrs)  
 (Exemptions), Chennai.

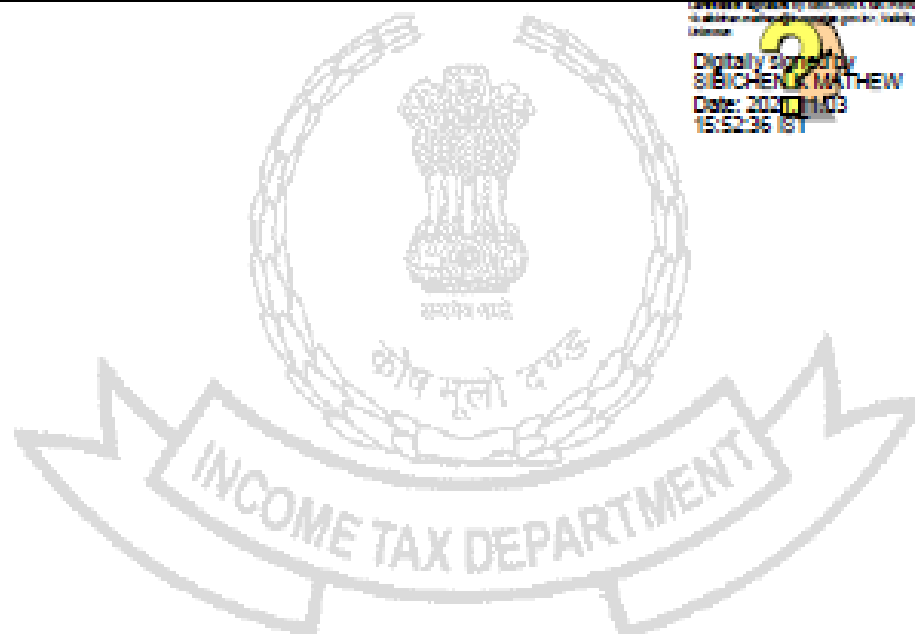
## FORM NO. 10AC

(See rule 17A/11AA/2C)

Order for registration

1	PAN	AACTN7857J
2	Name	NATURE SCIENCE FOUNDATION
2a	Address	
	Flat/Door/Building	LIG-II, 2669
	Name of premises/Building/Village	GANDHIMAA NAGAR
	Road/Street/Post Office	Coimbatore South
	Area/Locality	COIMBATORE
	Town/City/District	Gandhimsanagar S.O
	State	Tamil Nadu
	Country	INDIA
	Pin Code/Zip Code	641004
3	Document Identification Number	AACTN7857JE2021501
4	Application Number	739995830271021
5	Unique Registration Number	AACTN7857JE20215
6	Section/sub-section/clause/sub-clause/proviso in which registration is being granted	01-Sub clause (i) of clause (ac) of sub -section (1) of section 12A
7	Date of registration	03-11-2021
8	Assessment year or years for which the trust or institution is registered	From AY 2022-23 to AY 2026-2027
9	Order for registration:	
	a. After considering the application of the applicant and the material available on record, the applicant is hereby granted registration with effect from the assessment year mentioned at serial no 8 above subject to the conditions mentioned in row number 10.	
	b. The taxability, or otherwise, of the income of the applicant would be separately considered as per the provisions of the Income Tax Act, 1961.	
	c. This order is liable to be withdrawn by the prescribed authority if it is subsequently found that the activities of the applicant are not genuine or if they are not carried out in accordance with all or any of the conditions subject to which it is granted, if it is found that the applicant has obtained the registration by fraud or misrepresentation of facts or it is found that the assessee has violated any condition prescribed in the Income Tax Act, 1961.	
10	Conditions subject to which registration is being granted	
	The registration is granted subject to the following conditions:-	

<p>o. This certificate cannot be used as a basis for claiming non-deduction of tax at source in respect of investments etc. relating to the Trust/ Institution.</p>	
<p>p. All the Public Money so received including for Corpus or any contribution shall be routed through a Bank Account whose number shall be communicated to Office of the Jurisdictional Commissioner of Income Tax.</p>	
<p>q. The applicant shall comply with the provisions of the Income Tax Act, 1961 read with the Income Tax Rules, 1962.</p>	
<p>r. The registration and the Unique registration number has been instantly granted and if, at any point of time, it is noticed that form for registration has not been duly filled in by not providing, fully or partly, or by providing false or incorrect information or documents required to be provided under sub-rule (1) or (2) of rule 17A or by not complying with the requirements of sub- rule (3) or (4) of the said rule, the registration and Unique Registration Number (URN), shall be cancelled and the registration and URN shall be deemed to have never been granted or issued.</p>	
<p>Name and Designation of the Registration Granting Authority</p>	<p>Principal Commissioner of Income Tax/ Commissioner of Income Tax  (Digitally signed)</p>



## **Certificates of Green Campus Auditors**

1. ISO Environment Management System (14001:2015) of Mrs. S. Rajalakshmi, Chairman of NSF.
2. ISO Environment Management System (14001:2015 TUV NORD) of Dr. A. Geethakarhi, NSF Environment Auditor.
3. Indian Green Building Council (IGBC AP) Accredited Professional of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.
4. Associated Chambers of Commerce and Industry of India (ASSOCHAM), of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.
5. Associated Chambers of Commerce and Industry of India (ASSOCHAM), of Er. Ashutosh Kumar Srivastava, Board of Directors (North Zone) of NSF.
6. Botanist and Subject Expert of Plant Taxonomy of Dr. D. Vinoth kumar, Joint Director of NSF.
7. Bureau of Energy Efficiency (BEE) and National Productivity Council of Er. N. Dineshkumar and Dr. N. Balasubramanian, Energy Auditors of NSF.



## Certificate of Training

TNV hereby certifies that

**S. Rajalakshmi**

has successfully completed the 5 days

Auditor / Lead Auditor Training Course which meets the training requirements of the Exemplar Global and has been declared as competent in the following competency units

- EM: Environmental Management System
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 14001:2015**

Issue Date: 17<sup>th</sup> Jun. 2021

Training Date : 20<sup>th</sup> to 24<sup>th</sup> May. 2021

Certificate Number : 2106170721010105

Authorised Signatory  
(Pragyesha Singh)

**This course is certified by Exemplar Global vide registration number TN006669**

*Note: The course conforms to the principles and practice of audits of Management Systems for compliance with standards. This certificate remains the property of TNV and this certificate is recognized by Exemplar Global. For verification of this certificate, please write to Mail: [info@isoindia.org](mailto:info@isoindia.org)*



**PR315: ISO 14001:2015 Lead Auditor  
(Environmental Management Systems)  
Training course**

**Certificate of Achievement**

**Geethakarathi Alagarsamy**

has successfully completed the above mentioned course and examination.

23rd - 27th March 2019

COIMBATORE, INDIA

Certificate No. 35242817 02

Delegate No. 171136

for TÜV NORD CERT GmbH

Essen, 2019-04-26

The course is certified by CQI and IRCA (Certification No. 18125). The learner meets the training requirements for those seeking certification under the IRCA EMS Auditor certification scheme.

TÜV NORD CERT GmbH

Langemarckstraße 20

45141 Essen

[www.tuev-nord-cert.com](http://www.tuev-nord-cert.com)











## BUREAU OF ENERGY EFFICIENCY



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

Certificate Registration No. : **9176**

### Certificate For Certified Energy Manager

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

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

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

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


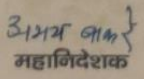
Given under the seal of the Bureau of Energy Efficiency, this **7<sup>th</sup>** day of **February, 2013**


Secretary  
Bureau of Energy Efficiency  
New Delhi

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

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

Regn. No. EA-7391		Certificate No. 5093
<b>National Productivity Council</b> (National Certifying Agency)		
<b><u>PROVISIONAL CERTIFICATE</u></b>		
<i>This is to certify that Mr. / Ms. .... <u>N. Balasubramaniam</u> .....</i>		
<i>son / daughter of Mr. .... <u>M. Nanjukuttigounder</u> .....</i>		
<i>has passed the National Certification Examination for Energy Auditors held in December - 2009, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.</i>		
<i>He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.</i>		
<i>He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.</i>		
<i>This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.</i>		
Place : Chennai, India		
Date : 11 <sup>th</sup> February 2010		Controller of Examination

	
<b>ऊर्जा दक्षता ब्यूरो</b> <b>BUREAU OF ENERGY EFFICIENCY</b>	
विद्युत मंत्रालय, भारत सरकार MINISTRY OF POWER, GOVERNMENT OF INDIA	
प्रमाणित किया जाता है कि	
श्री/श्रीमती <u>दिनेश कुमार</u> ने ऊर्जा संरक्षण भवन निर्माण संहिता के लिए <u>7 दिसंबर '16</u> से <u>8 दिसंबर '16</u> तक एम्पनआईटी / सीईपीटी / आईआईआईटी द्वारा आयोजित मास्टर ट्रेनर सर्टिफिकेट कार्यक्रम को सफलता पूर्वक सम्पन्न कर लिया है।	
This is to certify that	
Shri/Smt. <u>Dinesh Kumar</u> has successfully completed the Master Trainer Certificate Programme conducted by MNIT / CEPT / IIT from <u>7 December '16</u> to <u>8 December '16</u> for the Energy Conservation Building Code.	
New Delhi, <u>07 JUL 2017</u>	 महानिदेशक Director General



**10531234-AP-BD+C**

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CREDENTIAL ID

**26 DEC 2016**

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ISSUED

**25 DEC 2022**

---

VALID THROUGH


GREEN BUSINESS CERTIFICATION INC. CERTIFIES THAT

## DINESH KUMAR D

HAS ATTAINED THE DESIGNATION OF

### LEED AP<sup>®</sup> Building Design + Construction

by demonstrating the knowledge and understanding of green building practices and principles needed to support the use of the LEED<sup>®</sup> green building program.



MAHESH RAMARAJAM  
PRESIDENT & CEO, U.S. GREEN BUILDING COUNCIL  
PRESIDENT & CEO, GREEN BUSINESS CERTIFICATION INC.



## GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT

### GRIHA CERTIFIED PROFESSIONAL CERTIFICATE

This is to certify that

*Dinesh Kumar Dhanasekaran*

has qualified as a GRIHA Certified Professional For V. 2015

Date of issue: 19th June 2020

Note : This certification is valid only for GRIHA version 2015.



Chief Executive Officer  
GRIHA Council