

# ANDHRA UNIVERSITY

## Environmental Audit Report

### 2021-22



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# ANDHRA UNIVERSITY

VISHAKHAPATNAM

## Environmental Audit Report

In compliance with statutory requirement under the NAAC accreditation procedures criteria VII

2021-22

Date: 14<sup>th</sup>-15<sup>th</sup> Oct 2022

AUDITED BY

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**Date:** 1<sup>st</sup> November 2022

**Place:** Vishakhapatnam

**Authorized Signatory**

(Ashutosh Kumar Srivastava)  
**For G C Consultancy Services**  
M/s G C Consultancy Services

**Proprietor**

## Disclaimer

M/s G C Consultancy Services, Environment Audit Team has prepared this report for Andhra University, Vishakhapatnam based on input data submitted by their representatives of university complemented with the best judgment capacity of the expert team and samples collected by our team in presence of AU team members.

While all sensible care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the conclusions are arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements, or forecasts in the report.

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## Context and Concept

In India, the process for environmental audit was first mentioned under the Environment Protection Act, 1986 by the Ministry of Environment of forests on 13th march, 1992. As per this act, every person owning an industry or performing an operation or process needs a legal consent and must submit an environmental reporter statement.

The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory from the academic year 2019–20 onwards that all Higher Educational Institutions should submit an annual Green, Environment and Energy Audit Report. Moreover, it is part of Corporate Social Responsibility of the Higher Educational Institutions to ensure that they contribute towards the sustainable environment.

In view of the NAAC circular regarding environment auditing, the University management decided to conduct an external environment assessment study by a competent external professional auditor.

The term 'Environmental audit' means differently to different people. Terms like 'assessment', 'survey' and 'review' area, so used to describe similar activities. Furthermore, some organizations believe that an 'environmental audit' addresses only environmental matters, whereas others use the term to mean an audit of health, safety and environment-related matters. Al though there is no universal definition of Environment Audit, many leading companies/institutions follow the basic philosophy and approach summarized by the broad definition adopted by the International Chambers of Commerce (ICC) in its publication of Environmental Auditing (1989).

### **The ICC Defines Environmental Auditing as:**

“A management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing with the aim of safeguarding the environment and natural resources in its operations/projects.”

This audit focuses on the environment legal compliances and implementation of rules defined by MoEF&CC or CPCB, state pollution control board. The concepts, structure, objectives, methodology, tools of analysis are objectives of the audit are discussed below.

Ref: 2021-22/GA/Certificate

Date: -01/11/2022

## CERTIFICATE

This is to certify that a detailed "*Environment Audit*" for **Andhra University** has been conducted at its campus during the academic year 2021-2022 on 14<sup>th</sup> & 15<sup>th</sup> of October 2022. The Environment audit was conducted in accordance with the applicable standards prescribed by the Central Pollution Control Board (CPCB), New Delhi, and the Ministry of Environment, Forest, and Climate Change, (MoEF&CC), New Delhi. The audit involves Water, Air, Wastewater, Energy/ Renewable Energy, Hygiene, Sanitation, Green inventory, solid waste, plastic waste, and sewage waste etc., and given an '**Environmental Management Plan**' (EMP), which the university may follow to minimize the impact on the institutional working framework. In an opinion and to the best of our information and according to the information given to us, said Environment and it gives a true and fair view in conform, it with environmental audit in principles accepted in India.

Date: 1<sup>st</sup> November 2022

Place: Gorakhpur

Authorized Signatory & Seal



**For G C Consultancy Services**  
G C Consultancy Service, Vishakhapatnam

**Proprietor**

## Preface

It is a pride of Vishakhapatnam that on 2<sup>nd</sup> October 2022, Visakhapatnam bags fourth rank in Swachh Survekshan 2022 survey. Visakhapatnam was adjudged the fourth cleanest city in the country (In over 10 lakhs population category), as per the Swachh Survekshan 2022 rankings. The city has improved its rankings from ninth spot in the year 2021 to fourth this year. This is for the second time; the city has secured a place in the top four. In the Swachh Survekshan 2017, the city was declared third cleanest city, which was its best ranking so far.

This part, Visakhapatnam has secured two more awards in the Swachh Survekshan 2022. While one award was for securing five-star rating in **Garbage Free Cities** (GFCs), the other one was '**Clean Big City**' award in the category of 10 to 40 lakh population.

Environment auditing is the process of identifying and determining whether in situations practices are eco-friendly and sustainable. In objective to carryout agreed, audit is to check green practices followed by the university and to conduct a well-formulated audit report to understand where the university can optimize the uses of waste material as well as reduce its consumption of electricity and water. The initiative taken by **Andhra University** to conduct an **Environment Audit** of the university campus is a commendable sustainable goal. The strategies followed were the preparation of questionnaires and subsequent action plans to implement the project. Questionnaires prepared to conduct the green audit were based on the guidelines, rules, acts, and formats set by the Government of India, Ministry of Environment Forest & Climate Change, New Delhi, and Central Pollution Control Board, New Delhi. Questionnaires were prepared for solid waste, energy, water, hazardous waste. For audit purposes, analysis of suitable data is required, for the same study area is grouped into various Blocks and Departments. The audit was carried out for solid waste, electricity and energy, water and wastewater, hazardous waste, air quality, and green inventory including carbon footprints. It also indicates the green initiatives taken by universities to save environmental resources. The "**Environment Audit**" also presents the "**Environmental Management Plan**".

## INTRODUCTION

### *1. Environment Audit an Effective Efforts towards Environment Sustainability & Energy Conservation*

Modernization and industrialization are the two important outputs of the twentieth century that have made human life more luxurious and comfortable. Simultaneously, they are responsible for various use of natural resources, exploitation of forest and wildlife, producing passive solid waste, polluting the scarce and sacred water resources, and finally making our mother Earth ugly and in-hospitable. Today, people are getting more familiar with global issues like global warming, greenhouse effect, ozone depletion, and climate change, etc. Now, it is considered as a final call by Mother Earth to walk on the path of sustainable development. The time has come to wake up, unite and combat together for a sustainable environment.

Considering the present environmental problems of pollution and excessive use of natural resources, Hon'ble Prime Minister Shri Narendra Modi ji has declared the Mission of Swachh Bharat Abhiyan. Also, University Grants Commission has mentioned the "Green Campus, Clean Campus" mission mandatory for all higher educational institutes. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent. Govt. of India has issued National Education Policy 2020 and has issued white paper on its policy. Generation coming should be well conversant with the effects and impacts on Environment and Modernization/ Development. Coming generation must know how to make a balance in both.

Environment Audit is the most efficient ecological tool to solve such environmental problems. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. Through this process, the regular environmental activities are monitored within and outside of the concerned sites which have direct and indirect impacts on the surroundings. An environment audit can be one of the initiatives for such institutes to account for their energy, water resource use as well as wastewater, solid waste, hazardous waste generation. The environment Audit process can play an important role in the promotion of environmental awareness and sensitization about resource use. It can create consciousness towards ecological balance, values and ethics. Through the green audit, one can get direction about how to improve the condition of the environment without much affecting the impact on nature.

## 1.1 Why Environment Audit

Environment auditing is the process of identifying and determining whether an institution's practices are eco-friendly and sustainable. Traditionally, we are good and efficient users of natural resources. However, over the period of time excess use of resources like energy, water, chemicals are become habitual for everyone especially, in common areas. Now, it is necessary to check whether our processes are consuming more than the required resources? Whether we are handling waste carefully? In fact, as per modern thinking there is waste as such. ***The policy of Waste to Wealth has been the new concept introduced.*** Environment audit regulates all such practices and gives an efficient way of natural resource utilization. In the era of climate change and resource depletion, it is necessary to verify the processes and convert the min to green and clean ones. The environment audit provides an approach for it. It also increases over all consciousness and awareness among the people working in institutions towards an environment.

## 1.2 Goals of Environment audit

University has conducted an Environment audit with specific goals as:

- Assess facility of different types of waste management.
- All waste shall be first finding the scope of its use under ***Waste to Wealth policy.***
- Increase environmental awareness throughout campus.
- Identification and documentation of green practices followed by university.
- Identify strengths and weaknesses in green practices.
- Conduct a survey to know the ground reality about green practices.
- Analyze and suggest solutions for problems identified from the survey.
- Identify and assess environmental risk.
- Short-term goal of environment audit program.
- The long-term goal of the environmental audit program is to collect base line data of environmental parameters and resolve environmental issues.
- To motivate staff and student for optimized sustainable use of available resources.

## 1.3 Objectives of Environment audit

- To examine the current practices which can impact the environment such as resource utilization, waste management, etc.?



- To prepare an Environmental Statement Report on green practices followed by different departments, support services, and administration building.
- To set goals (Short/ Long), vision, and mission for Green practices on the campus.
- To identify and analyze significant environmental issues.
- To establish and implement Environmental Management Plan (EMP) in various departments and review them periodically.
- To assess for better performance in green practices and its valuation.

### **1.4 About Criteria 7 of NAAC**

Universities are playing a key role in the development of human resources worldwide. Government of India through NEP 2020 has framed the policy under which there shall be 4 verticals out of which NAC vertical will be governed for independently assessment of all HEIs. Higher education institutes campus run various activities with the aim to percolate the knowledge along with practical dimension among the society. Likewise, different technological solutions related to the environment are also provided by the higher education institutes. Different types of evolutionary methods are used to assess the problem concerning the environment. It includes Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Carbon Footprint Mapping, environment audit, etc.

National Assessment and Accreditation Council (NAAC) is a self-governing organization that rated the institutions according to the scores assigned at the time of accreditation of the institution. Environmental Audit has become a mandatory procedure for educational institutes under NEP 2020 and in Criterion VII of NAAC. The intention of the green audits is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental parameters like optimum use of water and wastewater (approach of recycling and reusing of the same) and accounting, energy conservation, possibilities of new/renewable energy, waste management, air, noise monitoring, facilities for females and differentially abled persons etc. for making the institution eco-friendlier.

Students are the major strength of any academic institution. They are also the future of the nation. Hence educating the Practicing green action in any educational institution will inculcate the good habit of caring for natural resources in students. *Many environmental activities like plantation and nurturing saplings and trees, Cleanliness drives, Bird watching camps, no vehicle*

day, Rainwater harvesting, etc. will make the students good citizens of the country, Through Green Audit, higher educational institutions can ensure that they contribute towards the reduction of global warming through Carbon Footprint reduction measures.

### **1.5 Benefits of Environment Audit to an Educational Institute**

There are many advantages of green audit to an Educational Institute.

- It would help to protect the environment in and around the campus.
- Recognize the cost-saving methods through waste minimization and energy conservation.
- Empower the organization to frame a better environmental performance.
- It portrays a good image of the institution through its clean and green campus.
- More efficient resource management
- To create a green campus
- To enable waste management through reduction of waste generation, solid and waste.
- To create plastic-free campus and evolve health consciousness among the stakeholders.
- Recognize the cost-saving methods through waste minimizing and managing.
- Authenticate conform it with the implemented laws.
- Empower the organizations to frame a better environmental performance.
- Enhance the alertness for environmental guidelines and duties.
- Impart environmental education through systematic environmental management approach and improving environmental standards.
- Benchmarking for environmental protection initiatives.
- Financial savings through a reduction in resource use.
- Development of ownership, personal and social responsibility for the University and its environment.
- Developing an environmental ethic and value systems in youngsters.
- Green auditing should become a valuable to link the management and monitoring of environmental and sustainable development programs of the University.
- Finally, it will help to build a positive impression through green initiatives

for the upcoming NAAC visit.

## 1.6 Introduction of Auditing Firm

M/s. G C Consultancy Services is a fast growing committed consultancy firm. The quality and adoption of CPCB, SPCB norms is the commitment. It is one of the fast-growing Organization in Energy audit, renewable energy, water conservation, waste management, air quality services providing company executed several projects covering all the diversified field Sectors & states of India. The Director and his associate team members are very well experienced in the field of Environment, Energy Audits. The associate team and experts are highly qualified and experienced in the field of diversified Environment Audit and Services. Individual credential of each member in the field of Energy Audit is very rich due to their past association with the very reputed organization of Auditing sectors. The company has Head office at Gorakhpur, Uttar Pradesh.

Name of Firm	M/s G C Consultancy Services
Address	614, Vasant Enclave, Rajender Nagar, Gorakhnath, Gorakhpur. 273015
Contact details	7007794292, 9919935600 Email id: <a href="mailto:gccs4114@gmail.com">gccs4114@gmail.com</a>

## 1.7 Director's Detail

Sr. No.	Name	Designation	Qualification and Technical Experience
1	Er. Ashutosh Kumar Srivastava Director	Principal Auditor 33 Years of Experience	BE (Civil), Lead Auditor ISO 9001, 14001, 22001, 45001, 50001, IGBC AP, ASSOCHAM GEM CP, Expert in water audit, air audit, waste management
2	Dr. Anita Srivastava	Head for documentation & Preparation of report	Ph. D (Botany), Rajasthan University, Jaipur. Rajasthan
3	Er. Dinesh Kumar	Energy Auditor 12 Years of Experience	B.E.(Mech), LEED AP BD+C   IGBC AP   GRIHA CP   BEE Certified Energy Auditor   ECBC Master Trainer   PQP   EDGE Expert   GEM CP

4	Dr. Vinoth Kumar	Jt. Director, NSF, Coimbatore, TN	<i>Ph.D (Botany)</i>
5	Er. Sunkara Sree Rohita Swathi	Environment Expert 5 years' Experience	<i>B.E (Civil), Lead Auditor ISO 9001, 14001, IGBC AP. IOSH MS, NEBOSH International General Certificate in Occupational Health &amp; Safety</i>

M/s G C Consultancy Services Registered in Ministry of Micro, Small & Medium Enterprises (**MSME**) as Micro unit, registered in **NSIC** under Environment Consultancy services.

### **1.8 List of Instruments**


Following are the instrument used at the time of the Environment Audit.

Sr. No.	Instrument	Make and Sr. No.
1	Water testing kits at site	<i>Prerana Laboratories</i>
2	Air Quality test	<i>Prana Laboratories</i>
3	Temperature gun 1 Set (infrared Thermometer)	<i>Cyclops L Portable pyrometers</i>
4	Lux Meter 1 Set (Digital Lux Meter)	<i>Fluke lux meter. Conforms to IEC 61010, CAT III 600V safety rated</i>
5	Flue gas Analyzer	<i>Testo 330i: the future of flue gas analysis.</i>

## About Andhra University

### 2.1 Andhra University

Andhra University is a public university located in Visakhapatnam, Andhra Pradesh, India. It was established in 1926.

Latitude & Longitude  17°43'45.38"N 83°19'17.61"E

King Vikram Deo Verma, the Maharaja of Jeypore was one of the biggest donors of the university. He donated lands and two million rupees for the establishment of the university which was set to be shifted elsewhere by the education authorities due to lack of funding. Furthermore, he provided ₹1 lakh annually to the university, an approximate figure of ₹17 lakhs between 1930s - 1940s. The liberal king was conferred an Honorary Doctorate degree from the university. The Jeypore College of Technology and Science in Andhra University was founded by Maharajah Vikram Deo.

### 2.2 University emblem

The university emblem was designed by Sri Kowta Rammohan Sastri with the guidance of Cattamanchi Ramalinga Reddy. The rising sun represents the university itself and the radiating light rays representing its faculties of study. The lotus is the seat of Goddess Lakshmi (prosperity) and Saraswati (knowledge). The swastika is the symbol of benediction. An ocean is the vast region of knowledge. The two serpents represent the seekers and custodians of wisdom.

### 2.3 Motto of Andhra University

<b>Motto</b>	"May the Divine Light illuminate our studies"
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### 2.4 Faculties and departments

- Andhra University College of Arts and Commerce (established 1931)
- Andhra University College of Engineering (established 1955)
- Andhra University College of Engineering for Women (established 2010)
- Andhra University College of Law (established 1945)
- Andhra University College of Pharmaceutical Sciences (established 1951)
- Andhra University College of Science and Technology (established 1931)
- Andhra University School of Distance Education (established 1972)
- Andhra University was ranked 1001+ in the world by the *Times Higher Education World University Rankings* of 2020 and 351–400 in Asia. The QS World University Rankings of 2020 ranked it 351–400 in Asia. It was ranked 36th in India overall by the *National Institutional Ranking Framework* in 2020 and 19th among universities. NIRF also ranked

the Andhra University College of Pharmaceutical Sciences 34th in India in the pharmacy ranking.

## 2.5 Notable alumni

- Venkaiah Naidu, Vice President of India
- Satya N. Atluri, Mechanical Engineering (1959-1963), recipient of the Padma Bhushan Award for 2013 in science & engineering
- Kambhampati Hari Babu, electronics and communications engineering, member of the 16th Lok Sabha<sup>[19]</sup>
- G. M. C. Balayogi, 12th Speaker of Lok Sabha
- Neeli Bendapudi, 18th president of the University of Louisville in Louisville, Kentucky, US, president elect of Penn State University
- Jasti Chelameswar, judge of Supreme Court
- B. M. Choudary, inorganic chemist, Shanti Swarup Bhatnagar laureate
- Undurti Narasimha Das, immunologist, Shanti Swarup Bhatnagar laureate
- Kunchithapadam Gopalan, geochronologist, Shanti Swarup Bhatnagar laureate
- Chennupati Jagadish, applied physics 1977–1980, Companion of the Order of Australia
- Pilli Alfred James, public administrator
- S. Rao Kosaraju, Computer Science (1959–1964), founder of the Kosaraju's algorithm, which finds the strongly connected components of a directed graph
- Kolluru Sree Krishna, geophysicist, Shanti Swarup Bhatnagar laureate
- Ipsita Pati, Philanthropist and Bollywood Actress.
- K. Padmanabhaiah, former secretary, Ministry of home affairs, Government of India
- N. S. Raghavan, Electrical Engineering 1959–1964, co-founder of Infosys
- Anumolu Ramakrishna, former Deputy Managing Director of Larsen & Toubro and Padma Bhushan recipient
- B. L. S. Prakasa Rao, statistician, Shanti Swarup Bhatnagar laureate and National Science Foundation Fellow<sup>[20]</sup>
- Barry Ramachandra Rao, space physicist, Shanti Swarup Bhatnagar laureate
- C. R. Rao, statistician, National Medal of Science laureate<sup>[21]</sup>
- G. S. R. Subba Rao, natural product chemist, Shanti Swarup Bhatnagar laureate
- Grandhi Mallikarjuna Rao, Mechanical Engineering, founder and Chairman of the GMR Group, an infrastructure enterprise
- Neelamraju Ganga Prasada Rao, plant breeder, popularly known as the "father of hybrid sorghum", Shanti Swarup Bhatnagar recipient
- B. S. Daya Sagar, geoengineering (1988–1994), only Asian recipient of Georges Matheron Lectureship Award from International Association for Mathematical Geosciences
- B. L. K. Somayajulu, geochemist, Shanti Swarup Bhatnagar laureate
- Adusumilli Srikrishna, organic chemist, Shanti Swarup Bhatnagar laureate
- Trivikram Srinivas, MSc (Nuclear Physics), film director
- Raghu Rama Krishna Raju, Member of Parliament in 17th Lok Sabha<sup>[22]</sup>
- Duvvuri Subbarao, economist and former Reserve Bank of India Governor<sup>[23]</sup>
- Varanasi Subramanyam, Indian Maoist politician

- P. Susheela, An Indian playback singer associated with the South Indian Cinema
- Srinivasan Varadarajan, chemist and Padma Bhushan awardee

The University is spread in a sprawling lush green campus of **423.15 acres** dotted with 121 buildings of Academic, Administrative and support services with a plinth area of about 20 lakhs sq. ft., and 324 staff quarters.

## **2.6 Area of Andhra University**

It occupies a sprawling campus of **423.15 acres** dotted with more than 100 buildings. Former President of India and a great Philosopher Dr. Sarvepalli Radhakrishnan served Andhra University as the second Vice- Chancellor.

It is located in a sprawling campus over **423.15 acres** with full of lush green flora and fauna.

Andhra University is a non-profit public higher-education institution located in the urban setting of the metropolis of Visakhapatnam (population range of 1,000,000-5,000,000 inhabitants), Andhra Pradesh. Officially recognized by the University Grants Commission of India, Andhra University (AU) is a very large (uniRank enrollment range: over-45,000 students) coeducational Indian higher education institution. Andhra University (AU) offers courses and programs leading to officially recognized higher education degrees such as bachelor's degrees in several areas of study. See the Rank degree levels and areas of study matrix below for further details. This 96 years old Indian higher-education institution has a selective admission policy based on entrance examinations. International students are welcome to apply for enrollment. AU also provides several academic and non-academic facilities and services to students including a library, housing, sports facilities, online courses and distance learning opportunities, as well as administrative services.

The University Presently is Offering 313 Courses in Arts, Commerce, Management, Science & Technology, Engineering, Law, Pharmacy and Education. The University has **five constituent colleges** and four AU Campuses.

### **2.7.0 Facilities & Services**

#### **2.7.1 Hostels**

Hostel facility is available to both boys and girls, though for a limited number of students. Students from outside Visakhapatnam can seek admission into the hostels by applying to the Chief Warden of the Hostels.

#### **2.7.2 Medical Centers**

Both allopathic and homoeopathic medical centers are functioning on the campus. There are two allopathic medical centers, one in the North Campus and the other in the South Campus. The homoeopathic medical Center is situated next to the telegraph office.

### **2.7.3**      *Cyber Laboratory*

A Cyber Laboratory with internet facility has been established next to the Department of English for the benefit of students, scholars and staff. Anyone wishing to make use of this facility can do so by becoming a member.

### **2.7.4**      *Library*

The University Library, officially designated Dr. V.S. Krishna Library, is one of the biggest libraries in the country with about 4,00,000 books. The library subscribes to many national and international journals in all disciplines. There is a Reading Room attached to the library for the benefit of the students. The Reading room and the Textbook section are kept open round the clock.

### **2.7.5**      *Games and Sports*

There are two playgrounds, viz., The Silver Jubilee playground and the Golden Jubilee Play ground on the campus. There is a department of Physical Education too. In addition, there is also a Gymnasium.

### **2.7.6**      *Yoga*

There is a Yoga Village on the beach road, attached to the Institute for Yoga and Consciousness, where various training programs in yoga are conducted.

### **2.7.7**      *Psychological Services*

Psychological assessment and counselling is available in the department of Psychology and Parapsychology. Those who wish to avail the services are required to take a prior appointment in person.

### **2.7.8**      *NSS*

There is an NSS unit in the University, situated near the School of Distance Education, to encourage students to be involved in social service activities.

### **2.7.9**      *Assistance to Foreign Students*

There is a Foreign Students' Advisor on the campus, who coordinates and monitors the requirements of the foreign students. Prof. U. Tataji of the Department of Sociology is the present Foreign Students' Advisor.



### 2.7.10 *Extra-Curricular Activities*

Students are encouraged to take part in the campus Beautification Program including gardening and horticulture, and also in the Janma Bhoomi Program and the Clean and Green Program of the Government of Andhra Pradesh.

### 2.7.11 *Other Academic Programs*

A remedial Course in English is conducted by the Department of English to cater to the needs of students with a rural background and to improve their communication skills.

### 2.7.12 *Support Services Available*

- ❖ Central Library
- ❖ Computer Centre
- ❖ Health Centre
- ❖ Sports facilities
- ❖ Press
- ❖ Workshop
- ❖ Hostels
- ❖ Guest Houses
- ❖ Housing Accommodation
- ❖ Canteen
- ❖ Welfare Schemes
- ❖ Grievance Redress Cell
- ❖ Vehicle Parking Shed
- ❖ Non-Resident Centre

### 2.8 *Others*

- ❖ Faculty Club
- ❖ Ladies Waiting Halls
- ❖ Banking facilities
- ❖ Training and Placement Cell
- ❖ Homeo Dispensary
- ❖ Creche Centre
- ❖ High School
- ❖ Employment Information & Guidance Bureau
- ❖ Post Office
- ❖ Telegraph Office

## **2.9 *Bulletin of AU Research Forum***

The University constituted a Research Forum in which the lectures are delivered by the Senior Faculty Members and other dignitaries once in a week. These lectures expect a better interaction in research among the teachers of different departments. The Research Forum brings out a monthly bulletin called Bulletin of AU Research Forum to cover the summaries of lectures delivered and extended abstracts of paper presented or published by the Faculty at the National and International Seminars of Journals.

## **2.10 *Best Research Award***

Andhra University Awards **BEST RESEARCH AWARD** every year at its Convocation to teachers who made rich research contributions during the last couple of years. Such a felicitation is aimed for promoting serious research among the teachers.

## **2.11 *Best Employees Award***

Andhra University also awards **BEST EMPLOYEES AWARD** to all categories of non-teaching members have been introduced by Honorable Vice-Chancellor for the past two years on the eve of Independence Day and Republic Day Celebrations along with a Cash Award of 1,116/- each for recognizing their meritorious services rendered to the University.

## **2.12 *Telephone Facilities***

Recently the authorities have installed a telephone facility (coin facility) at the premises of the Arts College, Registrar's Office, and at various Hostels, exclusively for the benefit of students and the guests who visited the Campus. The same facility is being extended to the Office of the Principal, AU Colleges of Arts and Commerce in due course.

## **2.13 *Complaint/Suggestion Box***

Complaint/Suggestion box has already been installed at the Office of the Registrar and in due course, there is a proposal to install a Complaint/Suggestion Box at the Office of the Principal, AU Colleges of Arts and Commerce. All such complaints or suggestions will be attended to by the concerned officers as per the directions of the authorities from time to time and some of the suggestions will be forwarded to the Vice-Chancellor for consideration and effective implementation.

## 2.14 Centre of Environment

### 2.14.1 VISION

- Develop the center as a reference and resource hub integrating knowledge and expertise in the specialty of environmental management and sustainable development.
- Contribute to the transformation of technology to the field for the betterment of the society through training, research and development and community/society development activities.
- Developing nodal agency for the development of environmental entrepreneurship and skill development.
- Environmental interventions and innovations

### 2.14.2 MISSION

- Centre acts as an environmental think tank for the state of Andhra Pradesh and neighbouring states and other Indian states of India.
- Provide excellent education in the field of environmental sciences and engineering, conduct basic and applied research, addressing management of natural resource, environmental challenges of humanity and industry in assisting the governments in policy development and governance.
- Promotion of interdisciplinary innovative research and dissemination of knowledge for the transformation of lives and livelihoods towards sustainable development.
- Support the government in its efforts in environmental management, addressing climate change challenges and sustainable development through apposite research
- Promoting partnership with various stakeholders like students, institutions, industry, governments, business organizations, Non-government Organizations, and local communities.

## 2.15 PROLOGUE

Andhra University, constituted in the year 1926, is one of the oldest academic institutions of India. It is located in the coastal city of Visakhapatnam, Andhra Pradesh (AP). It has various departments with distinguished faculty members. They strive for its excellence through teaching, research, and outreach activities not only for educating, training, and preparing students to be the future leaders in their respective disciplines but also for serving their communities through practical and innovative means. The university by virtue of its coastal location and its talented faculty and students can serve the need of the day, i.e., protection of our environment, conserving resources by establishing a Center for Environment, Sustainable Development and

Climate Change. An integrated approach is highly appropriate to achieve all the Sustainable and Millennium Development Goals. Also, such a Center would be well suited to undertake interdisciplinary research and developmental studies by collaborating with national and international organizations. This can be achieved by the Andhra University not only by utilizing the internal resources of the university but also through the center along with memoranda of understanding with like-minded institutions or organizations to synergize and obtain appropriate solutions for problems of air, water, and soil pollution and adverse effects of climate change. The Government of Andhra Pradesh is implementing several innovative policies and programs for the protection of environment and conservation of natural resources. The state has already prepared an Environmental Improvement Act aiming at primarily protecting the environment and its resources and strategic directions for improvement in environmental conditions. The state started a separate corporation viz. "Andhra Pradesh Environmental Management Corporation" probably the first of its kind in India by a state government. It clearly shows the commitment of the government towards environmental protection and wellbeing of the people of the Andhra Pradesh. It shows the environmental vision and mission of the present Honorable Chief Minister of Andhra Pradesh Sri. Y. S. Jaganmohan Reddy Garu. In addition, the Government is aiming at taking several measures for environmental improvement, continuous monitoring of environmental parameters and developing an index system for tracking progress towards sustainable development goals. The State has the vision to provide water to the needy through diversion of water to drought hit area from areas where and when surplus water is available. The State is already implementing several programs or schemes for natural resources development and management at all levels and sectors in rural, semi-urban and urban areas or regions. Water, land and soil are integral parts of the environment that need to be conserved and efficiently managed to the life's sustenance, enhance productivity, achieve economic growth and promote environmental quality. Population increase demands the need to enhance agricultural productivity with scientific management of water, land and soil. An integrated approach in sustainable integrated natural resources development and management is obligatory for success in the state's efforts to alleviate poverty, food security and mitigate hardships of the people. The increase in population and the demands, it is necessary to achieve self-sufficiency and protection of our environment in various sectors such as supply of safe drinking water, provision of hygienic sanitation, protection of water bodies, Enhanced natural resources productivity using best management practices, improving blue economy, efficient storm water management, effective solid waste management, the protection of public health and mitigation of the adverse effects of climate change, application of IoT to optimize solutions for environmental pollution problems and so on. Hence, a holistic understanding and adaptation of the environmental management practices should be imparted to all the stakeholders to utilize the precious natural resources in an effective and efficient manner. The state has vision to provide water to the needy through diversion of water to drought hit area from areas where and when surplus water is available. In addition, the water demand deficit will be met through technological interventions to reclaim the water. The AP state is already implementing several programs and schemes for natural resources development and management at all levels and sectors in rural, semi-urban and urban areas or regions. Andhra University, being the oldest and leading university in the Andhra

Pradesh, is always at the forefront towards discharging its societal responsibilities. It is also a nodal point for the other universities in guiding the academic activities. Andhra University is the first university to introduce B.Tech. (Civil Environmental Engineering) in India and one among the first few to start MTech. (Public Health and Environmental Engineering) program in India. Andhra University is also catering to the needs of the government, both central and state, at various levels in their efforts to achieve the environmental protection, resource management and recovery, and sustainability in the field of environment under the able leadership of the Vice-Chancellor (FAC) Prof. P.V.G.D. Prasad Reddy. At this juncture the university administration felt that it should proactively work in the field of environmental management and sustainability towards better environment, health and society. Keeping this in view, 'CENTER FOR ENVIRONMENT, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (CESCC)' is established on 5th June, 2020, in the Andhra University, Visakhapatnam as part of discharging its societal responsibility through active participation in the holistic growth and development of Andhra Pradesh.

## ***2.16 CENTER FOR ENVIRONMENT, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (CESCC):***

The "CENTER FOR ENVIRONMENT, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (CESCC)" will coordinate with the governments at various levels of local bodies, both urban and rural authorities, for a healthier environment and society. The eventual objective is to create trained professionals, promoting R&D in the field of environmental management and sustainable development and transfer of the knowledge to the needy / society. All the activities of the center will be in accordance with the mandate of the university and in accordance with its norms, rules and regulations in force from time to time.

### ***2.16.1 GOALS AND OBJECTIVES***

The prime goal of the center is to promote education, research, and outreach the needy society.

- Provide practical education in the fields of environmental management, climate change and sustainable development and a mending it as a destination of choice for higher learning in the country.
- Making it as a distinctive research and development institution with committed faculty and researchers to benefit the economy, society and the environment.
- Collaborate with academic, governmental, non-governmental, business, industry and non-profit organizations that have similar objectives as the center to create synergy to address the issues and challenges in the natural resource and environmental management, climate change and sustainable development.
- Emerging as a preferred partner for creating technological solutions and policy innovations.
- Contributing to the knowledge base for the government initiatives in the field of environment, climate change and sustainable development.

- Search for multidisciplinary approach to the possible challenges to the public health and hygiene.
- Development of various suitable programs in the field of environment, climate change and sustainability.
- Act as an urban observatory for the improvement of the functioning of urban and local bodies.
- Taking up R & D activities in the thrust areas of Environment, climate change and sustainable development.
- Instrumental in designing and development of skill development programs.
- Disseminating the knowledge to the society through community development programs.
- Interaction with national and international institutions of repute for collaboration, sharing of knowledge in a mutually beneficial way.
- Addressing the issues of government organizations / department and local industries for better environmental management.
- Taking up projects for the development of innovative research and incubation with outcomes to the benefit of the environment and society.
- Adopting leading edge technologies and world-class best practices to achieve the goals.

### **2.16.2 DIVISIONS OF THE CENTRE**

The center intends to have the different divisions to take up the specialized activities of various characteristics of the environment management, climate change, natural resources management and sustainable development. Principally, it consists of the following four departments.

- Environmental Management
- Natural Resource Management
- Climate Change
- Sustainable Development

All the Divisions should be part of the activities of the center contributing towards the center's goals and objectives. Each division will take up the work related to its specialization. It is mandatory to take part in cross sectoral works cutting across the specialization.

### **2.16.3 STRUCTURE OF THE CENTRE**

The Director will be the head of the center. Each of the divisions will be headed by Head of the Division. Change of the administrative structure may be as per the norms of the university in place from time to time. The general structure of the CESSC is presented in Figure 1. The following initial organizational structure is suggested; this will be appropriately modified as needed to include grants development division, interdepartmental liaison and other functions to carry out various studies at the center.



Figure-1 The General Structure of the CESCC, Andhra University

Each department can have divisions as per the requirements of the center / university. The CESCC should mandatorily function as per the university rules, regulations, guidelines and administrative systems.

#### 2.16.4 *ACADEMIC ACTIVITIES OF THE CENTRE*

The center is established to take up academic activities like undergraduate, post graduate, doctoral and postdoctoral programs. It is being one of the first few universities to start UG and PG programs in environmental engineering in the India. The center aims at continuing the same, will start new courses and programs in the field of environment management, climate change, natural resources management and sustainable development. Teaching, research and extension services are part of the academic activity. It emphasizes learning through traditional Indian systems with hands on experience and learning through practice to acquire knowledge and skills simultaneously. The academic atmosphere should provide a friendly environment for inculcating innovation and creativity. The center takes up multidisciplinary and disciplinary research integrating the engineering and science in the said areas of interest. The major thrust areas, in which the center will undertake projects for scientific, engineering, sociology, and economics related studies are Air Resources (Ambient Air Pollution– Micro and Macro levels), Water Resources (Management of water resources, Pollution of Surface Water, Groundwater, and Seawater, Industrial Wastewater Treatment and Management, Solid Waste and Hazardous Waste Management) and Land Resources (Pollution of Land by Wastes, Agricultural Utilization of Wastewaters by Recycling and Reuse, Afforestation and Mitigation of Adverse Effects of Climate Change). As part of education, research and outreach of the CESCC, Andhra University the following are envisaged

- Develop a strong curriculum in natural resource management, environmental management and sustainable development studies comparable to those offered by

leading environmental education institutions of the world for the award of advanced degrees in the fields of environmental sciences and engineering.

- ii. Compete for opportunities to develop and train the best students who will be the leaders of tomorrow to be engaged to tackle complex environmental pollution problems.
- iii. Develop modern laboratories to characterize various types of pollutants and pollution of the air, water, and land resources within the districts that the Center wants to serve.
- iv. Develop a library and resource center to house books, journals, periodicals, and GIS relevant to environmental studies.
- v. Plan and organize various outreach activities such as conducting workshops, expositions, awareness programs, forums, and conferences on various topics, and developing multimedia approaches to inform and educate public on environmental topics.
- vi. Develop and integrate databases on the quality of water and air within the coastal districts of Andhra Pradesh.
- vii. Offer training to environmental professionals and conduct workshops relevant to the needs of the region in the areas of air and water pollution, and climate change effects.
- viii. Build effective communication channels to inform challenges, solutions to environmental problems, and opportunities, to different stakeholders ranging from members of the local communities to policy makers.
- ix. Conduct studies on the sociological and economic impacts of sources of pollution and their effect on the environment and public health.
- x. Develop collaborative activities with internationally reputed universities to exchange knowledge.

The continuing education and training of the industrial personal in various specializations will also be part of the center. The faculty includes regular, visiting, and honorary working from across universities / institutions / governmental organizations and industry from within India and also from abroad. It enables the center to become internationally recognized center of excellence in the field of environment management, climate change, and natural resources management on sustainable development. All the activities will be in accordance with the mandate of the university and in accordance with its norms, rules and regulations in force from time to time.

#### **2.16.5 RESEARCH AND DEVELOPMENT**

The research and development activities of the Centre are part of its activities taken up by the faculty, researchers, and students. Some of the activities include

- i. Develop strong interdisciplinary interactions and partnerships to carry out basic and applied research to collectively solve complex environmental problems. These interdisciplinary pursuits will engage students and faculty from engineering (civil and environmental, chemical, mechanical, electrical and computer engineering branches),



sciences (chemistry, physics, meteorology, biology, marine sciences, microbiology, biochemistry, biotechnology etc.) social sciences, economics, statistics, public health, and medical disciplines.

- ii. Work on projects that foster the health of ecosystems, natural resources conservation, energy conservation, collection, and treatment of wastewater, recycle and reuse of wastewater and other residuals generated in communities.
- iii. Identify research needs to conserve water supplies of tribal areas and protect them from pollution.
- iv. Explore the possibility of mitigating the adverse effects of climate change through reducing greenhouse gas emissions, energy conservation, and promoting afforestation.
- v. Apply for grants for finding appropriate technologies to solve the problems in the various faculties of the CESCC.
- vi. Develop a program to address environmental pollution problems relevant to the coastal marine waters such as the discharge of industrial and municipal wastes and offshore drilling operations.

The center intended to take up contemporary research projects such as Impact of COVID-19 Crisis and Lockdown on Environment, Biodiversity and Related Areas etc. along with other thrust areas.

#### **2.16.6 COLLABORATIVE RESEARCH AND EXTENSION SERVICES**

Expert team of academic staff, researchers, and students of the center can take part in the extensive services which include the continuing education / training, providing solutions to the issue and challenges through collaborative research / consultancy, community services in rural and urban area for better environment and neighborhood.

- i. Foster relationships and encourage collaborative efforts between and among national and international environmental agencies and organizations.
- ii. Work with the state surface and groundwater agencies and strengthen its monitoring programs by interaction of the faculty and students.
- iii. Develop databases on information related to both surface and groundwater resources of the region and identify needs for amelioration of polluted waters as needed.
- iv. Conduct various outreach and extension service activities as needed by the society at large, industry, and governmental agencies.
- v. Publish a newsletter to create awareness among various stakeholders related to environmental affairs around the state, nation, and the world.

As part of collaborative services, the centers will also emphasis on Environmental Entrepreneurship and Management.

#### **2.17 List of institutions of higher education in Andhra Pradesh**

In Andhra Pradesh there are 3 central universities, 20 Autonomous Institutions, 25 state universities, 4 deemed universities, and 5 private universities.

## 2.18 Colleges under Andhra University

There are **365 affiliated colleges** spread across five districts under the territorial jurisdiction of Andhra University. The enrolment in Affiliated Colleges is about one Lakh.

## 2.19 Total land area, sqft of buildings and other facilities of Andhra University

- The total campus area of Andhra University is 774.42 acres, of which 423.15 acres is in Vizag, 51.3 acres is in Kakinada, 200 acres is in Vizianagaram, and 100 acres is in Tadepalligudem
- The total built-up area of the above 4 campuses put together is 55 lakh sft, of which Vizag campus alone accounts for 54 lakh sft
- The Vizag campus of 423.15 acres is not in one single contiguous area. It is spread across different areas of the city (North campus – 183 acres, South campus – 202 acres, East campus – 3 acres, Shivajipalem – 26 acres, Vizianagar palace – 2.13 acres, MVP Colony – 3.96 acres, Maharanipeta ladies' hostel – 2.36 acres, Seethamahal – 0.61 acres, Lawsons Bay Colony – 0.06 acres)
- 563 buildings (academic – 69, administrative – 15, common halls – 9, guest houses – 7, hostels – 39, staff quarters – 324, e classrooms – 15, seminar halls – 85)
- 39 hostels (plus 3 hostels for international students) with total occupancy of 6523

### 2.19.1 Library

- V S Krishna library is main library and 4 other libraries ((i) Engineering College Library (ii) Law College Library (iii) a library attached to the Academic Staff College (iv) library in School of Distance Education
- V S Krishna library has:
  - more than 5lakh books, volumes
  - seating capacity - 700
  - 60,000 sft carpet area

### 2.19.2 Halls

- Sri Cattamanchi Ramalinga Reddy Utsavarangam (capacity – 3000)
- K.V. Gopalswamy Open Air Auditorium (capacity – 1000)
- Dr. Ambedkar Assembly Hall (capacity – 600)
- Dr. Ambedkar Auditorium (capacity – 250)
- T.L.N. Sabha Hall (capacity – 250)
- Y.V.S. Murthy Auditorium (capacity – 250)
- Meditation Hall (capacity – 250)

### 2.19.3 Sports facilities

- There are 2 playgrounds
- Cricket fields
- Gymnasiums
- 6 tennis courts
- Basketball courts
- Volleyball courts
- Indoor stadium
- Yoga center
- Bowling machine

### 2.19.4 Cafeteria



*Hon'ble V. C of Andhra University, interacting with the Audit Team members (Internal & External Team) and IQAC Coordinator of AU*



*Respected Registrar of Andhra University with the audit team*



## 3.0

## Environmental Audit

### *3.1.0 Environment audit methodology*

#### *3.1.1 Pre-Audit Stage*

A pre-audit meeting provided an opportunity to reinforce the scope and objectives of the audit and pre-audit discussions were held on the basis of green initiatives taken and the current scenario of the University campus. This meeting is an important pre-requisite for the environment audit because it is the first opportunity to understand the concerns. It was held with the concerned person of the University regarding initiatives taken by the University and regarding the last NAAC Environment Audit conducted by the University. The online meeting was an opportunity to gather the information that the audit team can study before arriving on the site. The audit protocol and audit plan were handed over at this meeting and discussed in advance of the audit itself. The pre-audit meeting was conducted successfully, and necessary documents were collected directly from the University before the initiation of the audit processes. The actual planning of audit processes was discussed in the pre-audit meeting. An Audit team was also selected in this meeting with the help of staff and the University management. The audit protocol and audit plan were handed over at this meeting and discussed in advance of the audit itself.

#### *3.2.0 Management Commitment*

The Management of the University has shown a commitment towards Environment auditing during the pre-audit meeting. They were ready to encourage all green activities. It was decided to promote all activities that are environmentally friendly such as awareness programs on the environment, campus farming, planting more trees on the campus, etc., after the green auditing. The management of the University was willing to formulate policies based on an environment auditing report.

#### *3.3.0 Objectives of the study*

A clean and healthy environment aids effective learning and provides a

conductive learning environment. There are various efforts around the world to address environmental education issues. Environment Audit is the most efficient and ecological way to manage environmental problems. It is a kind of professional care that is the responsibility of each individual who is part of economic, financial, social, environmental factors. It is necessary to conduct an environment audit on a university campus because students become aware of the environment audit, its advantages to saving the planet and they become social and responsible citizens of our country. Thus, Environment audit become necessary at the university level. The broad objectives are as follows.

- 3.3.1 Diagnosing the environmental problems to eliminate them.
- 3.3.2 Environmental education through a systematic environmental management approach.
- 3.3.3 Improving environmental standards.
- 3.3.4 Benchmarking for environmental protection initiatives.
- 3.3.5 Efficient utilization of resources.
- 3.3.6 Financial savings through conservation of water and electricity and selling/reusing waste materials.
- 3.3.7 Function in resource use.
- 3.3.8 Curriculum enrichment through practical experience.
- 3.3.9 Development of ownership, personal and social responsibility for the University and its environment.
- 3.3.10 Developing environmental ethics and value systems in young people.
- 3.3.11 Providing certain recommendations based on environmental audit reports.
- 3.3.12 Ensuring compliance, not only with laws, regulations, and standards but also with company policies and the requirements of an Environmental Management System (EMS) standard.
- 3.3.13 Enabling environmental problems and risks to be anticipated.
- 3.3.14 To demonstrate that University is aware of its impact upon the environment.

### ***3.4.0 Audit Stage***

Environment Audit was done with the help of co-associates involving different student groups, teaching, and non-teaching staff. The Environment audit began with the teams walking through all the different facilities at the University,

determining the different types of appliances and utilities as well as measuring the usage per item (Watts indicated on the appliance or measuring water from a tap) and identifying the relevant consumption patterns (such as how often an appliance issued) and their impacts. The staff and learners were interviewed to get details of usage, frequency, or general characteristics of certain appliances. Data collection was done in the sectors such as Water quality, water quantity, Energy, Waste management, Green Area, Carbon footprint, and hygiene & sanitation use. University records and documents were verified several times to clarify the data received through surveys and discussions.

### ***3.5.0 Methodology***

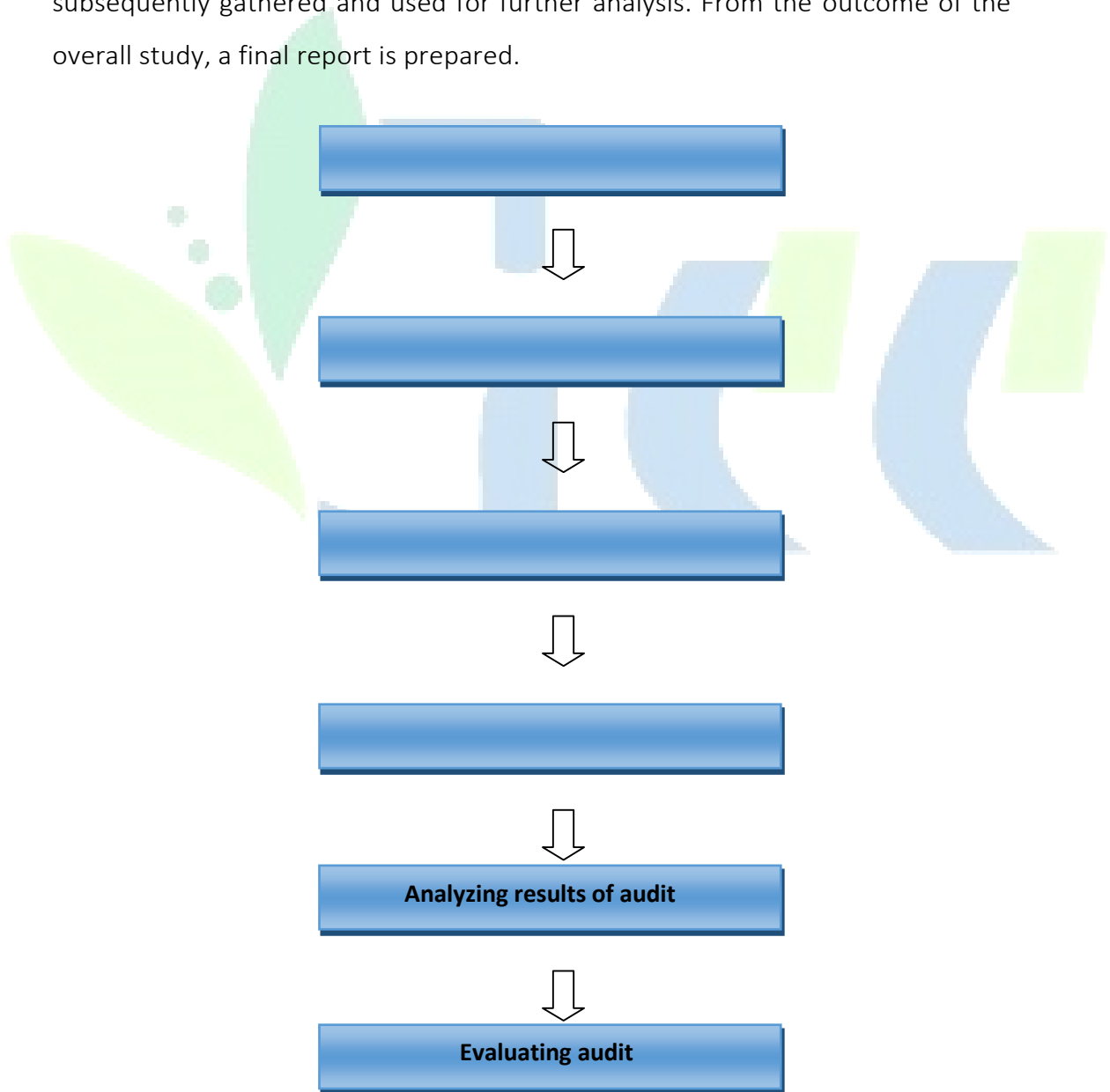
The Management of the University has shown a commitment towards environment auditing during the pre-audit meeting. They were ready to encourage all green activities. It was decided to promote all activities that are environmentally friendly such as awareness programs on the environment, campus farming, planting more trees on the campus, etc., after the green auditing. The management of the University was willing to formulate policies based on a green auditing report. In order to perform green audits, the methodology included different tools such as preparation of questionnaires, physical inspection of the campus, observation, and review of the documentation, interviewing key persons, and data analysis, measurements, and recommendations. The study covered the following areas to summarize the present status of environmental management on the campus:

- Energy Management
- Water Quality & Quantity Management
- Waste Management
- Environment Management
- Air quality Management
- Hygiene & sanitation

### ***3.6.0 Methodology–Step by Step***

The audit process was carried out in three phases. At first, all the secondary data

required for the study was collected from various sources, like concerned departments such as engineering cell, horticulture section, etc. A broad reference work was carried out to clear the idea of environment auditing. Different case studies and methodologies were studied, and the following methodology was adopted for the present audit. The methodology of the present study is based on onsite visits, personal observations, and questionnaires survey tools. Initially, based on data requirements, sets of questionnaires were prepared. The surveyors then visited all the departments of the university, and the questionnaires were filled. The generated data is subsequently gathered and used for further analysis. From the outcome of the overall study, a final report is prepared.





### **3.7.0**     *Survey by Questionnaire*

Baseline data for environment audit report preparation was collected by questionnaire survey method. Questionnaires are prepared to conduct the green audit in the university campus based on the guidelines, rules, acts, and formats prepared by the Ministry of Environment, Forest and Climate Change, New Delhi, Central Pollution Control Board, and other statutory organizations. Most of the guidelines and formats are based on broad aspects and some of the issues or formats were not applicable for the University campus. There for, using the guidelines and formats, combinations, modifications, and restructuring were done and sets of questionnaires were prepared for solid waste, energy/renewable energy, water, hazardous waste, and e-waste data, air quality, hygiene & sanitation.

All the questionnaires are a group of modules. The first module is related to the general information of the concerned department, which broadly includes the name of the department, month and year, the total number of students and employees, visitors of the department, average working days and office timings, etc. The next module is related to the present consumption of resources like water, energy, or the handling of solid and hazardous waste. Maintaining records of the handling of solid and hazardous waste is much important in environment audits. There are possibilities of loss of resources like water, energy due to improper maintenance, and assessment of this kind of probability is necessary for the green audit. One separate module is based on the questions related to this aspect. Another module is related to maintaining records, like records of disposal of solid waste, records of solid waste recovery, etc. For better convenience of the surveyor, some statistics like basic energy consumption characteristics for electrical equipment, etc. were provided with the questionnaires.

### **3.8.0**     *Onsite visit and observations*

Andhra University has a vast built-up area comprising various departments under various academic buildings, teachers and staff quarters, many facilities including Academic Buildings, Guest House, Health Centre, Council hall, Auditorium, other facilities and separate men's and women's hostels. All these buildings were visited by the surveyors and the present condition is checked with the help of the questionnaires. Personal observations were made during the onsite visit. All the amenities were clubbed in, as per their similarities and differences, which makes the survey and further analysis easier. For the data compilation purpose, the University Departments and support services were clubbed into Three Types of Buildings and given names as academic buildings, Facilities Buildings, and Hostel Buildings. The detail of the Building as follows:

Sr No.	Name of the Buildings
1.	Academic Buildings
2.	Facilities Buildings
3.	Hostel Buildings

After the collection of secondary data, the reviews related to each environmental factor were taken by the environment audit team. The data were tabulated, analyzed and graphs were prepared. Depending upon the observations and data collected, interpretations were made. The lacunas and good practices were documented. The **Environmental Management Plan (EMP)** was prepared for the next academic year in order to have better environmental sensitization. Finally, all the information was compiled in the form of the Environment Audit Report.

### ***3.9.0 Data analysis and final report preparation***

Proper analysis and presentation of data produced from work is a vital element. In the case of an environment audit, the filled questionnaires of the survey from each group were tabulated as per their modules, in Excel spreadsheets. The tabulated data is then used for further analysis. For a better understanding of the results and to avoid complications, averages, and percentages of the tables were calculated. A graphical representation of these results was made to give a quick idea of the status. Interpretation of the overall outcomes was made which incorporates all the

primary and secondary data, references, and interrelations within. Final report preparation was done using this interpretation.

#### 4.0 Internal Audit Team

Sr. No.	NAME	DEPARTMENT
1.	Prof. D. Lalitha Bhaskari	Coordinator, IQAC, Department of Computer Science & Systems Engineering, A.U.
2.	Prof. P. Malikarjuna Rao	Head of the Department, Department of Electrical Engineering, A.U.
3.	Prof. S. Bala Prasad	Department of Civil Engineering, A.U.
4.	Prof. Vazeer Mahmood	Department of Civil Engineering, A.U.
5.	Dr. K. Rajashekar	Department of Civil Engineering, A.U.
6.	Mr. Naveen	Office staff of IQAC office



*Meeting of External and internal audit team with IQAC Coordinator of Andhra University*

#### 5.0 WATER & WASTEWATER AUDIT

Water is a precious natural national resource available with affixed quantum. The availability of water is decreasing due to the increasing population of the nation; as per capital availability of utilized water is going down. Due to the ever-rising standard of living of people, industrialization, urbanization, demand for fresh water is increasing day by day. The unabated discharge of industrial effluent in the available water bodies is reducing the quality of these ample sources of water continuously. Hence, the national mission on water conservation was declared by the Honorable Prime Minister Narendra Modi as '*Jal Shakti Abhiyan*' and appealed to all

citizens to collectively address the problem of water shortage, by conserving every drop of water and suggesting conducting water audits for all sectors of water use. Water audit can be defined as a qualitative and quantitative analysis of water consumption to identify means of reducing, reusing, and recycling water. Water Audit is nothing but an effective measure for minimizing losses, optimizing various uses, and thus enabling considerable conservation of water in their irrigation sector, domestic, power, and industrial sectors. A water audit is a technique or method which makes it possible to identify ways of conserving water by determining any inefficiency in the system of water distribution. The measurement of water losses due to different uses in the system or any utility is essential to implement water conservation measures in such an establishment.

### **5.1 Importance of Water Audit**

- Systematic process
- May some surprising results
- Easier to work on solutions when the problems are identified.
- Attracting mechanism can be put into place.

It is observed that several factors like climate, culture, food habits, work and working conditions, level and type of development, and physiology determine the requirement of water. The community which has a population between 20,000 to 1,00,000 requires 100 to 150 liters per person (capita) per day. The communities with a population over 1,00,000 require 150 to 200 liters per person (capita) per day. As per the standards provided by WHO Regional Office for Southeast Asia Schools require 2 liters of water per student for drinking purposes; 10-15 liters per student for Water-flush toilets. Administration requires (Staff Accommodation not included) 50 liters per person per day.

### **5.2 Water Audit**

The University is spread in a sprawling lush green campus of **423.15 acres** dotted with 121 buildings of Academic, Administrative and support services with a plinth area of about 20 lakhs sq. ft., and 324 staff quarters. Approximately strength of student and staff is 50,000.

Water usage can be defined as water used for all activities which are carried out on campus from different water sources. This includes usage in all residential halls, academic buildings, on-campus, and on-grounds. Wastewater is referred to as the water which is transported off the campus. The wastewater includes sewerage; residence water used in cooking, showering, clothes washing as well as wastewater from chemical and biological laboratories which ultimately go down in the sink or drainage system.

### 5.3 Water Quality

Primary Water Quality Criteria for Bathing Waters, in a water body or its part, water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for a particular purpose. Among the various types of uses there is one use that demands highest level of water quality or purity and that is termed as "Designated Best Use" in that stretch of water body. Based on this, water quality requirements have been specified for different uses in terms of primary water quality criteria. The primary water quality criteria for bathing water are specified along with the rationale in table 1. PRIMARY WATER QUALITY CRITERIA FOR BATHING WATER (Water used for organized outdoor bathing) CRITERIA 1. Fecal Coliform MPN/100 ml: 2. Fecal Streptococci MPN/100 ml: 2. pH: 3. Dissolved Oxygen: 4. Biochemical Oxygen demand 3-day,27°C: 500 (desirable) 2500 (Maximum Permissible) 100 (desirable) 500 (Maximum Permissible) Between 6.5 -8.5 5 mg/l or more 3 mg/l or less RATIONALE to ensure low sewage contamination. The desirable and permissible limits are suggested to allow for fluctuation in environmental conditions such as seasonal change, changes in flow conditions etc. The range provides protection to the skin and delicate organs like eyes, nose, ears etc. which are directly exposed during outdoor bathing. The minimum dissolved oxygen concentration of 5 mg/l ensures reasonable freedom from oxygen consuming organic pollution immediately upstream which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediment. The Biochemical Oxygen Demand of 3 mg/l or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.

#### 5.3.1 Drinking Water Quality

The principal source of water for Vishakhapatnam is through across the Gostani River located at 70 kms from the city or ground water. The ground water of Vishakhapatnam contains Designated Best Use Water Quality Criteria Designated-Best-Use Class of water Criteria Drinking Water Source without conventional treatment but after disinfection

A. Total Coli Forms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20C 2mg/l or less Outdoor bathing (Organized)

B. Total Coli Forms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less Drinking water source after conventional treatment and disinfection

C. Total Coli Forms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less Propagation of Wild life and Fisheries

D. pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less Irrigation, Industrial Cooling, Controlled Waste disposal

E. pH between 6.0 to 8.5 Electrical Conductivity at 25C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l

### 5.3.2 WHO Drinking Water Specifications Updated On: 11 Oct 2019:

WHO produces international norms on water quality and human health in the form of guidelines that are used as the basis for regulation and standard setting, in developing and developed countries worldwide. The quality of drinking water is a powerful environmental determinant of health. Assurance of drinking water safety is a foundation for the prevention and control of waterborne diseases. The guidelines developed by WHO are prepared through a vast global consultative process involving WHO member states (India is the member state), national authorities and international agencies, in consultation with the WHO Expert Advisory Panel.

Parameters	Standard limits as per WHO guidelines (mg/L)
Acryl amide	0.0005
Alachlor	0.02
Aldicarb	0.01
Aldrin and Dieldrin	0.00003
Ammonia	1.5
Antimony	0.02
Arsenic	0.01
Atrazine	0.002
Barium	0.7
Benzene	0.01
Benzo (?) pyrene	0.0007
Boron	0.5
Bromate	0.01
Bromodichloromethane (BDCM)	0.06
Bromoform	0.1
Cadmium	0.003
Carbofuran	0.007
Carbon tetrachloride	0.004
Chlorate	0.7

Parameters	Standard limits as per WHO guidelines (mg/L)
Chlordane	0.0002
Chloramines	0.5 - 1.5
Chloride	200 – 300
Chlorine	5
Chlorite	0.7
Chloroform	0.3
Chlorotoluron	0.03
Chlorpyrifos	0.03
Chromium	0.05
Colour in drinking water	No visible colour
Copper	2.0
Cyanazine	0.0006
Cyanide	0.07
1,2-Dichlorobenzene	1.0
1,4-Dichlorobenzene	0.3
1,2-Dichloroethane	0.03
Dichloromethane	0.02
2,4-Dichlorophenoxyacetic acid	0.03
DDT and metabolites	0.001
Di(2-ethylhexyl)phthalate	0.008
1,2-Dichloroethylene	0.05
1,2-Dichloropropane	0.04
Dimethonate	0.006
1,4-Dioxane	0.05
Dissolved oxygen	No health-based guideline value is recommended
Edetic acid (EDTA)	0.6
Endrin	0.0006
Epichlorohydrin	0.0004
Ethylbenzene	0.3
Fenoprop	0.009

Parameters	Standard limits as per WHO guidelines (mg/L)
Fluoride	1.5
Hexachlorobutadiene	0.0006
Iron	No health-based guideline value is proposed
Isoproturon	0.009
Lead	0.01
Lindane	0.002
Manganese	0.4
Mercury	0.006
Methoxychlor	0.02
Metolachlor	0.01
Microcystin-LR	0.001
Molinate	0.006
Molybdenum	0.07
Monochloroacetate	0.02
<i>N</i> -Nitrosodimethylamine	0.0001
Nickel	0.07
Nitrate	50
Nitrilotriacetic acid (NTA)	0.2
Nitrite	3
Pendimethalin	0.02
Pentachlorophenol	0.009
Permethrin	0.3
pH	No health-based guideline value is proposed
Pyriproxyfen	0.3
Selenium	0.01
Simazine	0.002
Sulphate	No health-based guideline value has been derived
Styrene	0.02
Terbutylazine	0.007
Tetrachloroethylene	0.04



Parameters	Standard limits as per WHO guidelines (mg/L)
Toluene	0.7
Total dissolved solids (TDS)	No health-based guideline value is proposed
Trichloroacetate	0.2
Trichloroethylene	0.02
2,4,6,-Trichlorophenol	0.2
Trifluralin	0.02
Trutuim	10000 Bq/L
Uranium	0.015
Vinyl chloride	0.0003
Xylenes-total	0.5
Zinc	No health-based guideline value is proposed

*Water contains naturally occurring compounds such as lead and arsenic among others. How harmful are these and what is the level of contamination we are exposed to?*

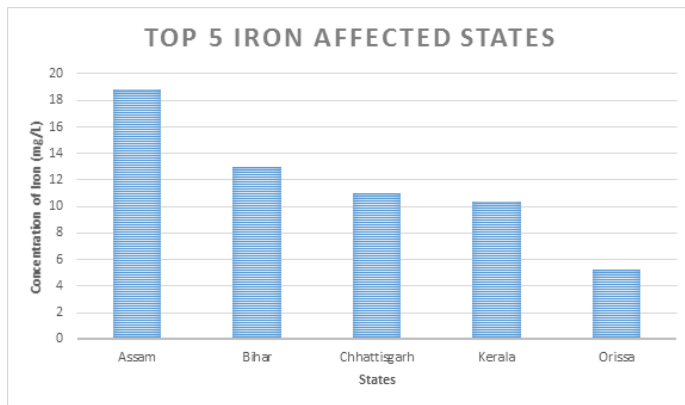
### 5.3.3 Water quality in India Source UNICEF Repository

Both rural and urban India is faced with water problems. People do not have access to good quality, safe drinking water. The source for most drinking water is either rivers or underground aquifers (wells). Since water can dissolve just about anything that it meets long enough, often the groundwater we get isn't pure.

It could contain naturally occurring lead, arsenic, mercury, radium, chloride, iron and copper compounds dissolved in it. Most of these aren't harmful when consumed in small quantities. But when the levels go higher than the prescribed amounts, it could be harmful and sometimes, even fatal. Let's analyze the effects of each of these compounds on our health and understand from the available data which states in India are susceptible to which types of contamination.

### 5.3.4 Iron

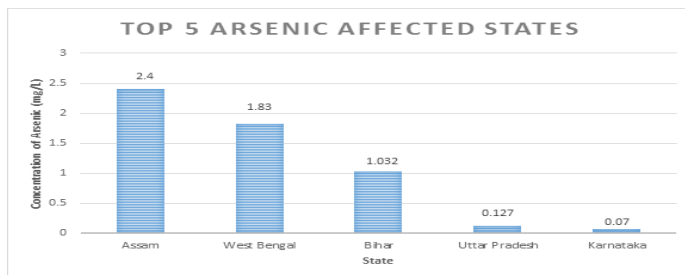
Iron, which is seldom found in concentrations greater than 10 milligrams per liter (mg/L) or 10 parts per million can be a troublesome chemical in drinking water. Corrosion of pipes is a common reason why iron is found in drinking water. As little as 0.3 mg/L concentration of iron can make the water appear brown. A laboratory analysis of the water sample can tell you the extent of your problem.



Top 5 iron-affected states in India

The best way to treat this is to use aeration/ filtration or chlorination techniques. Chlorination is the process of adding the element chlorine to the water to make it fit for human consumption.

### 5.3.5 Arsenic



Top 5 arsenic-affected states in India

Arsenic is a semi-metal found in various foods and mostly in groundwater. Elevated levels of arsenic lead to metabolism failure in the body causing severe heart diseases, night blindness, cancer and even diabetes. A study conducted by USA today.com states that around 70 countries are affected by arsenic poisoning from groundwater. Assam and West Bengal have high concentrations up to 2.4 mg/L and 1.83 mg/L respectively.

### 5.3.6 Chlorine and Fluoride

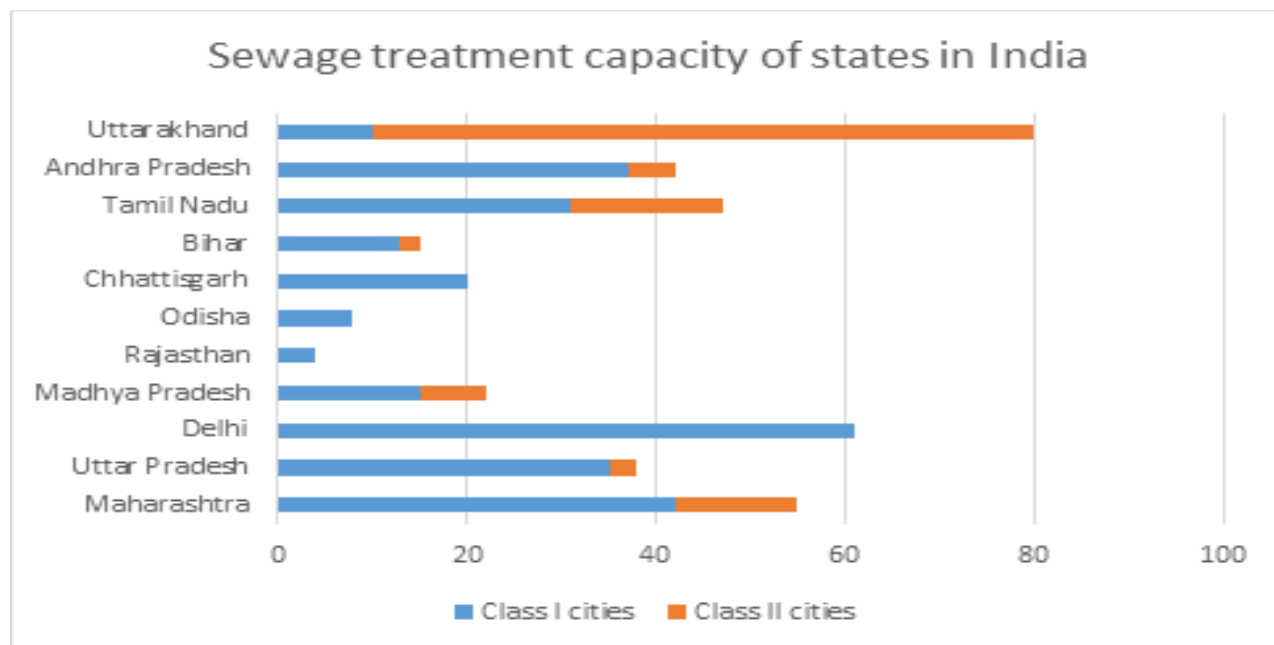
Chlorine and fluoride are added to water to kill pathogens, which are disease producing agents. An excess amount of chlorine in the water causes a problem because it leaves behind a residue. This “residual amount”, when consumed, reacts inside the stomach and damages some cells of the organs.

Fluoride is added in water just to prevent cavities, whether you have cavities or not! An excess amount of fluoride in water causes tooth discoloration forming yellow or brown pits and patches on teeth. Long term high exposure (more than 4 ppm) to fluoride may also result in bone spurs and birth defects. Rajasthan and Assam have the highest concentrations of these.

### 5.3.7 Nitrate

Nitrate, a naturally occurring form of nitrogen, is found in the soil. It is required in large quantities to sustain high crop yields. A tasteless, colorless and odorless compound, you cannot

detect it unless your water is chemically analyzed. If you drink water from a private well, get a qualified laboratory to test it yearly. Times of India reported, “Dental and spine-related ailments are showing up in many cities and villages of Karnataka due to increasing levels of Nitrate concentration in drinking water.”



#### 5.4 Sewage treatment capacity of states in India

The major cause of increasing nitrate content is open sewage disposal and the use of nitrogen fertilizers. Since rural sanitation in the country is poor, the presence of nitrates in water is evident of such contamination. Proper sewage treatment including contaminants and recycling of wastewater to reuse it for various uses like, gardening, toilet flushing and car washing is necessary to keep these levels down. Currently Maharashtra and Uttar Pradesh have the highest sewage treatment capacity in India in Class I cities.

From the above analysis, we can see the extent of contamination that we are exposed to. Here are some safeguards that we can take to get clean drinking water.

- Water supply protection is most effective before contamination occurs. Surface water must never be allowed to flow down in the well. Rainwater and runaway water should be sloped out of a water body. A minimum of 300 feet distance must be maintained between sewage disposal and water supply areas.
- Also, it is important to locate and eliminate the source of the contamination. For example, lead and iron contamination can be eliminated by replacing pipes, fittings and fixtures.
- New sources for water supply should be developed in case the existing supply is extensively contaminated with nitrate, salt, pesticides and other chemicals.
- Lastly, water must be treated to remove possible disinfectants and chemicals.

## 5.4 INDIAN STANDARDS FOR SAFE DRINKING WATER

- The Bureau of Indian Standards (BIS) has specified drinking water quality standards in India to provide safe drinking water to the people. It is necessary that drinking water sources should be tested regularly to know whether water is meeting the prescribed standards for drinking or not and, if not, then, the extent of contamination/ unacceptability and the follow-up required.
- Apart from BIS specification for drinking water, there is one more guideline for water quality, brought out by Ministry of Water Resources, Government of India in 2005. This is known as Uniform Protocol for Water Quality Monitoring. A need has arisen to have a separate uniform protocol for Drinking Water Quality Monitoring in view of increasing risk of geogenic and anthropogenic contamination.
- Keeping in view requirement of preparing Uniform Drinking Water Quality Monitoring Protocol, the Ministry of Drinking Water and Sanitation (MDWS), Government of India constituted an Expert Group which prepared the Protocol. The Drinking Water Quality Monitoring protocol describes specific requirements for monitoring drinking water quality with a view to ensure provision of safe drinking water to the consumers.

## 5.5 Definition of drinking water quality

5.5.1 BIS has set specifications in IS-10500 and subsequently the revised edition of IS 10500: 2012 in Uniform Drinking Water Quality Monitoring protocol.

5.4.2 Some parameters apart from those mentioned in IS 10500: 2012 may also be measured if the States deem it necessary. This standard has two limits i.e., Acceptable limits and permissible limit in absence of alternate source. If any parameter exceeds the limit, that water is considered unfit for human consumption.

5.4.3 Broadly speaking water is defined as unfit for drinking as per Bureau of Indian Standards, IS-10500-2012, if it is bacteriologically contaminated (presence of indicator Uniform Drinking Water Quality Monitoring Protocol bacteria particularly E-coli, viruses etc.) or if chemical contamination exceeds maximum permissible limits (e.g. excess fluoride [ $>1.5\text{mg/l}$ ], Total Dissolved Solids (TDS) [ $>2,000\text{mg/l}$ ], iron [ $>0.3\text{ mg/l}$ ], manganese [ $>0.3\text{ mg/l}$ ], arsenic [ $>0.05\text{mg/l}$ ], nitrates [ $>45\text{mg/l}$ ] etc.).

5.5.4 The latest drinking water specification and test protocol are –

Sr. No.	Test Parameter	IS: 10500-2012 Drinking Water Specification (Second Revision)		Method of Test (Indian Standard IS:3025 Methods of Sampling and Test for Water and Waste Water)
		Requirement (Acceptable limit)	Permissible limit In the Absence of alternate source	
1.	Odor	Agreeable	Agreeable	IS:3025 Part 5
2.	Taste	Agreeable	Agreeable	IS:3025 Part 8
3.	pH value	6.5 – 8.5	No relaxation	IS:3025 Part 11
4.	Turbidity, NTU, Max	1	5	IS:3025 Part 10
5.	Total dissolved solids (TDS), mg/l, Max	500	2000	IS:3025 Part 16
6.	Total alkalinity as CaCO <sub>3</sub> , mg/l, Max	200	600	IS:3025 Part 23
7.	Total hardness as CaCO <sub>3</sub> , mg/l, Max	200	600	IS:3025 Part 21
8.	Calcium as Ca, mg/l, max	75	200	IS:3025 Part 40
9.	Magnesium as Mg, mg/l, Max	30	100	IS:3025 Part 46
10.	Chloride as Cl, mg/l, Max	250	1000	IS:3025 Part 32
11.	Residual Free Chlorine, mg/l, Min*	0.2	1	IS:3025 Part 26
12.	Sulphate as SO <sub>4</sub> , mg/l, max	200	400	IS:3025 Part 24

Sr. No.	Test Parameter	IS: 10500-2012 Drinking Water Specification (Second Revision)		Method of Test (Indian Standard IS:3025 Methods of Sampling and Test for Water and Waste Water)
		Requirement (Acceptable limit)	Permissible limit In the Absence of alternate source	
13.	Nitrate Nitrogen as NO <sub>3</sub> , mg/l, Max	45	No relaxation	IS:3025 Part 34
14.	Fluoride as F, mg/l, Max	1.0	1.5	IS:3025 Part 60
15.	Total Iron as Fe, mg/l, Max	0.3	No relaxation	IS:3025 Part 53
16.	Coliform MPN/100 ml	Shall not be detectable in any 100 ml sample		Indian Standard IS:1622, Methods of Sampling and Microbiological Examination of water.
17.	Faecal Coliform, Presence/Absence	Shall not be detectable in any 100 ml sample		
18.	E.coli, Presence / Absence	Shall not be detectable in any 100 ml sample		

\*Applicable only when water is chlorinated

### 5.6 As per Central Ground Water Board report of September 2013:

**Table: II** General range of Important Chemical Constituents

Sr. No.	Constituent	Range		ISI Standards Desirable	Permissible
		Min	Max		
1	pH	7.43	8.90	6.5–8.5	No range
2	E.C/ $\mu$ S/cm at 25 <sup>o</sup> C	110	3263	750	3000
3	Total Hardness(mg/l)	45	660	300	600
4	Ca(mg/l)	8	166	75	200
5	Mg(mg/l)	1.0	113	30	100
6	Na(mg/l)	5.0	506	-	-

7	K (mg/l)	1.0	180	-	-
8	Co <sub>3</sub> (mg/l)	Nil	87	-	-
9	HCo <sub>3</sub> (mg/l)	24	634	-	-
10	Cl(mg/l)	7.0	695	250	1000
11	So <sub>4</sub> (mg/l)	0.5	192	200	400
12	No <sub>3</sub> (mg/l)	0.4	249	45	100
13	F (mg/l)	0.04	1.6	1.0	1.5

### Water Quality Samples:

## 5.7 Sample Quality of water in terms of pH, TDS, EC. At Andhra University

Tube well

S.No.	Place from where water sample collected	pH value	Permissible value	TDS	Permissible value	Electrical Conductivity E.C/μS/cm at 25°C	Permissible value
	1	2	3	4	5	6	7
1	Principal, AU Colleges of Arts and Commerce office	6.9	6.5 – 8.5 No relaxation	428	Acceptable Limit 500	635	Upto 750 (desirable) as per IS standards
2	Vice-Chancellor Office building	7.2	IS:3025 Part 11	453	IS:3025 Part 16	642	
3	Principal, AU Engineering Colleges office	7.2		462		627	
4	Law College Library	7.1		438		650	
5	Y.V.S. Murthy Auditorium	7.2		438		649	
6	Maharanipeta ladies hostel	7.2		443		652	
7	Lawsons Bay Colony	7.1		436		652	

## 5.8 Test for Bacteria presence in water

S. No	Sample collected from	Process adopted to test for bacteria	Result Presence of Bacteria	Chlorination in ppm IS:3025 Part 26	Result
	8	9		10	11

1	Principal, AU Colleges of Arts and Commerce office	It was tested through sample provided by Site kit by Prerana Laboratories	Negative	0.3	Safe for drinking
2	Vice-Chancellor Office building		Negative	0.2	Safe for drinking
3	Principal, AU Engineering Colleges office		Negative	0.3	Safe for drinking
4	Law College Library		Negative	0.3	Safe for drinking
5	Y.V.S. Murthy Auditorium		Negative	0.3	Safe for drinking
6	Maharanipeta ladies' hostel		Negative	0.3	Safe for drinking
7	Lawsons Bay Colony		Negative	0.2	Safe for drinking

### 5.9 Test for Copper, Sulphates and Fluorides

S.No	Sample	Iron (Fe) Mg/L	Permissible limit Mg/L	Fluoride as F, mg/l, Max	Permissible limit mg/l,	Presence of Sulphates Mg/l	Permissible Limit Mg/L
	12	13	14	15	17		18
1	Principal, AU Colleges of Arts and Commerce office	0.2	0.3 No relaxation	0.65	1.0 mg/l IS:3025 Part 60	159	200 Acceptable limit IS:3025 Part 24
2	Vice-Chancellor Office building	0.2	IS:3025 Part 53	0.68		128	
3	Principal, AU Engineering Colleges office	0.2		0.60		136	
3	Law College Library	0.2		0.60		139	
4	Y.V.S. Murthy Auditorium	0.2		0.60		144	
5	Maharanipeta ladies'	0.2		0.63		142	



	hostel				
6	Lawsons Bay Colony	0.2		0.60	143
	Sample	Coliform MPN/100 ml	Faecal Coliform, Presence/Absence	E.coli, Presence / Absence	
	19	20	21	22	
1	Principal, AU Colleges of Arts and Commerce office	Not Detected	Not Detected	Not Detected	
2	Vice-Chancellor Office building	Not Detected	Not Detected	Not Detected	
3	Principal, AU Engineering Colleges office	Not Detected	Not Detected	Not Detected	
4	Law College Library	Not Detected	Not Detected	Not Detected	
5	Y.V.S. Murthy Auditorium	Not Detected	Not Detected	Not Detected	
6	Maharanipeta ladies' hostel	Not Detected	Not Detected	Not Detected	
7	Lawsons Bay Colony	Not Detected	Not Detected	Not Detected	

### 5.10 Ground water

Vishakhapatnam is however safe for drinking as per the Ground water report as above but it is recommended to send sample to State Pollution Control Board approved Laboratory for testing.

### 5.11 Electrical Conductivity:

The lowest value of E.C ( $\mu\text{S}/\text{cmat } 25^{\circ}\text{C}$ ) was recorded at Gudem village as 110. Higher values of E.C more than 3,000 recorded as 3,263 at Addaroad village, 3,202 at Pudimadaka village, and 3,150 at Revupolavaram village. The EC increases from north to south i.e. towards Coast. Higher values of E care recorded at Addaroad, Pudimadaka, and Revupolavaram.

The lowest value of chloride recorded as 7 mg/l at Kottur and higher value was recorded at Pudimadaka village as 674 mg/l. The concentrations of Nitrates in the district range from a minimum of 0.4 mg/l at Lotugadda village, to maximum value of 249 mg/l at Pudimadaka. Fluoride in the area ranges from 0.04 to 1.6mg/l, by and large the area is free from fluoride hazards. The lowest value of 0.04 mg/l is recorded at Gudem village and maximum value of 1.6mg/l is recorded at Narsipatnam.

## **5.12 GROUND WATER RELATED ISSUES AND PROBLEMS**

Overall, there is no significant change in water levels in the district. However, at few places decline in water table exists, which suggests that suitable preventive steps to be taken. However, the magnitude of the decline is less. Water logging does not exist in Andhra University area.

Ground water pollution is not significant in the non-industrial area of the district. However, localized Nitrate pollution in the district is due to excess use of fertilizers, urban sewerage disposal and improper drainage system. Though district has a coastline of 132 km, no significant sea water intrusion/ ingress is reported. Heavy metal pollution of ground water exists in the Mindi-Chukkavanipalem industrial area due to the industrial effluents. In old city area of Visakhapatnam i.e. Kotaveedhi, Gnanapuram etc. ground water is already contaminated due to the marshy nature. In such areas well should be limited to shallow zones only.

Mass awareness programmes may be conducted to aware the people to adopt for construction of roof top water harvesting in a large scale so that rainwater can be harvested, and it will increase ground water resource. In Visakhapatnam Urban area it is evident from the investigations carried out by various agencies and scientific scholars the groundwater has also polluted within the vicinity of industries due to industrial effluents released without proper treatment. It is also reported the polluted ground water affecting adversely the human health of the people who are living in the industrial areas. So, it is recommended industry wise systematic micro level ground water quality studies may be taken up immediately and remedial measures may be taken up by the Government organizations and also the agencies involved in water related issues. Strict measures should be implemented to ensure the industrial effluents are properly treated before discharging into canals/surface drainage.

*According to International Journal of preventive medicine research Potential Health Impacts of Hard Water PMID: PMC3775162 PMID: 24049611, Int J Prev. Med. 2013 Aug; 4(8): 866–875.*

Total hardness includes both temporary and permanent hardness caused by the calcium and magnesium, based on which water is categorized as soft or hard and very hard. Several epidemiological investigations have demonstrated the relation between risk for cardiovascular disease, growth retardation, reproductive failure, and other health problems and hardness of drinking water or its content of magnesium and calcium. A good percentage of people who consumes hard water, which is considered to be a significant etiological factor around the globe

causing many diseases such as cardiovascular problems, diabetes, reproductive failure, neural diseases, and renal dysfunction and so on.

Table 2

Concentrations of dissolved calcium and magnesium in soft and hard water

<b>Dissolved calcium and magnesium</b>		
<b>Water</b>	<b>Milligrams per liter (mg/l)</b>	<b>Grains per US gallon (gpg)</b>
Soft	0-60	0-3.5
Moderate	61-120	3.5-7.0
Hard	121-180	7.0-10.5
Very hard	>180	>10.5

1 ppm=0.058 grains/US gallon

### 5.12.1 *pH value:*

A pH of 7 is considered neutral. That “seven” number is considered neutral or balanced between acidic and alkaline. If water is below 7 on the pH scale, it's "acidic." If it's higher than 7, it's "alkaline." EPA guidelines state that the pH of tap water should be between 6.5 and 8.5.

Acidic water with a pH of less than 6.5 is more likely to be contaminated with pollutants, making it unsafe to drink. It can also corrode (dissolve) metal pipes.

Many municipal water suppliers voluntarily test the pH of their water to monitor for pollutants, which may be indicated by a changing pH. When pollutants are present, water companies treat their water to make it safe to drink again.

### 5.12.2 *Alkaline water*

Alkaline water has become a popular drinking water choice over the past few years. Some people say that drinking slightly alkaline water — with a pH between 8 and 9 — can improve your health. They say it may make you age more slowly, maintain a healthy pH in your body, and block chronic disease like cancer.

**5.12.3 *Electrical Conductivity of Water:*** Pure water is not a good conductor of electricity. Ordinary distilled water in equilibrium with carbon dioxide of the air has a conductivity of

about  $10 \times 10^{-6} \text{ W}^{-1} \cdot \text{m}^{-1}$  (20 dS/m). Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases.

Electrical conductivity (EC) is a **measurement of water's ability to conduct electricity**. EC is related to water temperature and the total concentration, mobility, valence and relative concentration of ions. Higher EC means more electrolytes in the water.

The reason that the conductivity of water is important is because **it can tell you how much dissolved substances, chemicals, and minerals are present in the water**. Higher amounts of these impurities will lead to a higher conductivity.

Types of water	Conductivity Value
Pure distilled and Deionized water	0.05 $\mu\text{S}/\text{cm}$
Seawater	50 mS/cm
Drinking water	200 to 800 $\mu\text{S}/\text{cm}$ .
Rain or Snow water	2 to 100 $\mu\text{S}/\text{cm}$

$\mu\text{S}/\text{cm}$  means **micro Siemens per centimeter**, a measure of **electrical conductivity**; it is equal to  $\mu\text{mhos}/\text{cm}$ ; BASIS FOR CHANGE: The Department proposes to add this definition, which is the measure of conductivity in the International System of units, and to substitute it for  $\mu\text{mhos}/\text{cm}$  throughout the Standards. **1 PPM is equal to 1.56 micro S/cm.**

#### 5.12.4 Sulphates in drinking water

People who are not used to drinking water with high sulfate can get diarrhea and dehydration from drinking the water. Infants are often more sensitive to sulfate than adults. To be safe, only use water with a sulfate level lower than 500 milligrams per liter (mg/L) to make infant formula. Older children and adults may get used to high sulfate levels after a few days.

#### 5.12.5 Presence of Copper in water:

How to Protect Yourself and Your Family Drinking water with more than 1,300 micrograms of copper per liter of water ( $\mu\text{g}/\text{L}$ ) \* can be a health risk for everyone. Infants and people with Wilson's disease may need water with an even lower level of copper to stay safe. Copper can get into your drinking water as it passes through your plumbing system. Over time, plumbing parts with copper in them usually build up a natural coating that prevents copper from being dissolved into the water. Plumbing systems with copper parts fewer than three years old usually have not had time to build up this protective coating.

### 5.12.6 Presence of Fluorides in drinking water:

Fluoride prevents tooth decay by making teeth stronger and more resistant to acid attacks. It also helps with slowing down or stopping the decay process. When fluoride levels in water are at optimal levels, it helps to protect teeth against cavities. Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems, and chronic issues.

## 6.0 Water Quantity

### 6.1 According to the report

*The New Indian express 25th August 2020 09:12 AM the Ground water level of Vishakhapatnam Report:*

*There are 73 piezometers to estimate the water depth in the district. In some mandals such as Araku, Chukkaanipalem in Bheemili, Cheedikada, and Makavaripalem water is now available at one to two meters' depth.*

*There has also been an increase in water levels in various reservoirs in the district. Official sources said there will be no water problem at least till next summer.*

*The areas with severe water scarcity also witnessed rise in water tables. In the Sivajipalem area last year, the water table is 17.2 meters against the present level of 8.122 meters. Similarly, in Dwarakanagar and YSR Central Park, water level is 7.535 meters against last year's reading of 18.4 meters thus there is an increase of 10.865 meters.*

*At Ananthavaram in Padmanabham mandal, the water table rose by 6.36 meters and the water level now stands at 8.04 meters. Sources said if rainwater is tapped properly, the water levels will increase further. Residents should ensure that rain water flowed into rainwater harvesting structures. Water table readings of current period and August 19 last year in some places in the district are: Gopalapatnam 7.01 mts - 13.02 mts, Erravanipalem (Sabbavaram) 6.917 mts - 13.9 mts, Pendurthy 6.87 mts- 11.9 mts and Payakaraopeta 17.941 mts - 22.5 mts.*

### 6.2 Methodology for reduction in water consumption:

Here are a few methods that can reduce the usage of water inside buildings:

- 12 Rainwater Harvesting. Rainwater Harvesting is a method that can be quite easily implemented.
- 13 Water Metering. ...
- 14 Pressure reducing valves. ...

- 15 Water-saving showerheads. ...
- 16 Greywater Recycling system. ...
- 17 Smart irrigation systems. ...
- 18 Water-efficient toilets.
- 19 Float valves on the tanks above the quarters/ homes and buildings.

**6.3 Broadly speaking, you can reduce your direct water footprint by:**

- o Turning off the tap while brushing your teeth.
- o Using water-saving toilets.
- o Installing a water-saving shower head.
- o Taking shorter showers.
- o Only washing your clothes when necessary.
- o Fixing household leaks.
- o Using less water in the garden and when cleaning. Preferably use recycled water.
- o Adopting drip irrigation methods.

**6.4 Measure daily consumption data:**

As per Central Ground Water Authority As a general rule the following rates per capita per day may be considered for domestic and nondomestic needs: a) For communities with populations up to 20,000: b) For communities with : 100 to 135 lphd population 20,000 to 100,00 together with full flushing system c) For communities with population: 150 to 200 lphd above 100,000 together with full flushing system Note—The value of water supply given as 150 to 200 liter per head per day may be reduced to 135 liter per head per day for houses for Medium Income Group (MIG) and Low Income Groups (LIG) and Economically Weaker Section of Society (EWS), depending upon prevailing conditions and availability of water. Out of the 150 to 200 liter per head per day, 45 liter per head per day may be taken for flushing requirements and the remaining quantity for other domestic purposes.

**6.5 Measure the pumping hours:**

The best way to control the water is to measure daily water demand which is being extracted from the source. For this we can use Water Meter and Energy meter. Water meter is for water consumption and Energy meter is to check the energy consumed. Check it on daily basis. Find out the leakages and ultimately check where water consumption is more. At each overhead tank we should provide float valve so that unnecessary waste of water and energy shall be reduced. See the possibility if water consumption can be reduced. A periodical analysis will reduce the water and energy consumption to an optimum level.

Recharging of ground water through RWH

Observe the Ground water table before and after monsoon.

Please do observe the ground water recharge position (Level whether increase or decrease). This will give an extra credit for achieving the ground water recharge to the University.

Participation of student groups should be made so as to further increase their awareness towards the water conservation.

## 6.6 University water resources

The major resource for the water in the university is a self-reliant water boring system installed on the campus. There are 36 numbers of tube-wells installed of 5 HP & 3 HP capacity motors, 17 numbers in South Campus & 15 in North Campus. Out of total 1300 KL/ Day supply University is taking 600KL/ Day supply from Municipal water (350 KL/Day for South Campus & 250 KL/ Day for North Campus. Balance 700 KL/ Day of water is being taken from Ground water. There are 324 Staff quarters and 13,000+ (approx. Students & Staff members).

Total consumption of the campus is approx. 1300 Kilo Liters per day out of which 700 KL of water is being taken from tube well by operating discharge pumps with a total discharge capacity of 700 Kilo Liters for 12 hours per day. Out of this, 180 KL for bathrooms, 70 KL for toilets, 50 KL for gardening, 30 KL for urinals, 40 KL for wash Basins, 250 KL for colonies, 150 KL for different departments, 180 KL for mess. There is no record for 200 KL of water (presumably leakages).

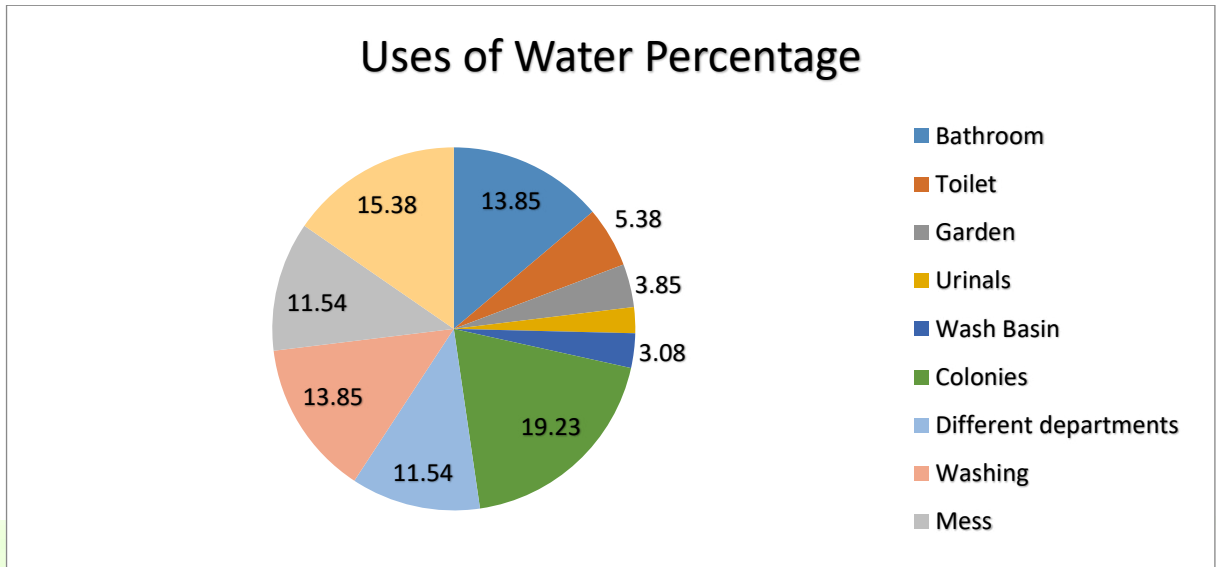
## 6.7 Water consumption in the University

From the data collected for water audit of Andhra University, the water distribution and water consumption pattern are noticed as follows.

*Yearly Average Water Consumption at Andhra University*

Sr. No.	Sector	Total Daily Use(KL)	Total Monthly Use (KL)	Total Yearly use (KL)	Percentage %
1	Bathroom	180	5,400	64,800	13.85
2	Toilet	70	2,100	25,200	5.38
3	Garden	50	1,500	18,000	3.85
4	Urinals	30	900	10,800	2.31
5	Wash Basin	40	1,200	14,400	3.08
6	Colonies	250	7,500	90,000	19.30
7	Different departments	150	4,500	54,000	11.54

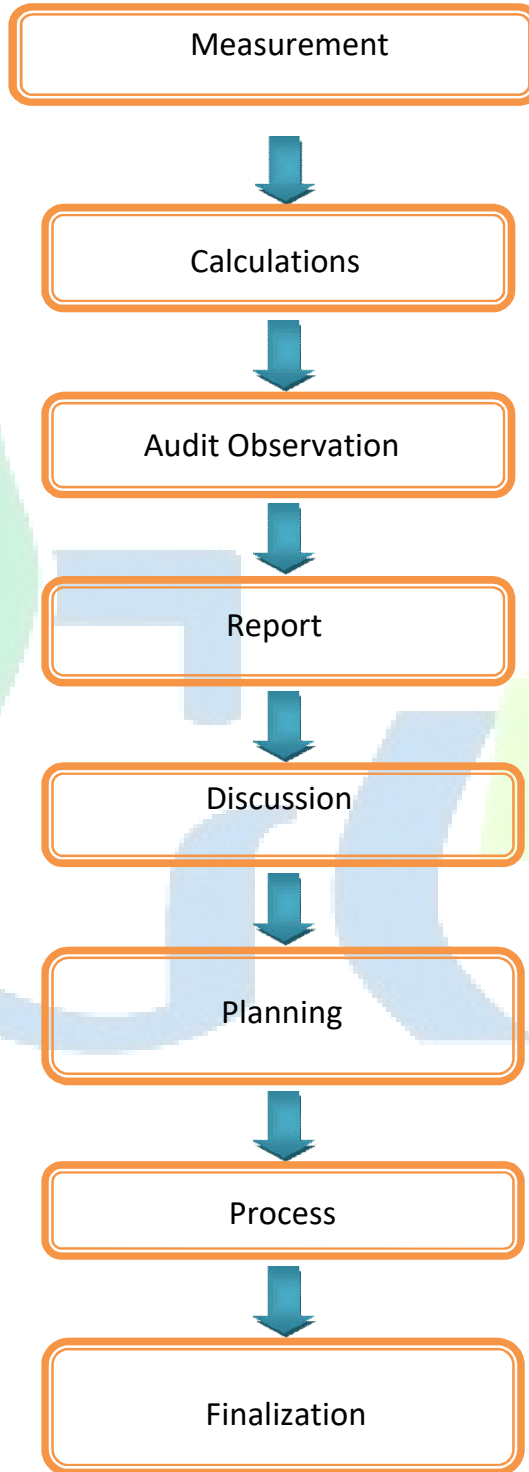
8	Washings	180	5,400	64,000	13.67
9	Mess	150	4,500	54,000	11.54
10	Water loss at discharge	200	6,000	72,000	15.38
Total		1300	39,000	4,68,000	100



*Thus, from above data as provided by AU Engineer's office 15.38% is the unaccounted water. This water if reduced can save 15% of revenue as well as same amount of energy consumed. Also water used for washing 13.67%. This total 15.38% + 13.67% could be saved if recycled water be used for in place of fresh water.*



## Water Audit Process



## **6.8 Yearly Average Water Consumption at Andhra University**

The Figure shows the total percentage of water consumed by all the Building Blocks of Andhra University, Vishakhapatnam. The figure shows that toilets, washbasins, and bathrooms as the major sources of water utilization comprising 27.40%, 23.04%, and 19.68% respectively. The other uses namely garden, urinals, laboratory, and shower consume water with yearly water requirements of 8.73%, 6.71%, 6.38%, and 5.15% respectively. Further also includes water required for drinking purposes, and loss of water during filling and during discharge which is 2.84%, 0.05%, and 0.02%. It was observed that the water required for drinking purposes is 2.84%. In the case of filling loss of water was observed 0.05% and during discharging water, the loss is about 0.02% only.

## **6.9 Sustainable Water Practices**

### **6.9.1 Watershed Management Practices**

Andhra University has taken many initiatives in water conservation and management of water available on the campus. Now, the university is self-reliant through decentralized water conservation and management practices.

### **6.10 Wastewater Filtration Tank**

The university has a huge campus with its administrative setup and there is a lot of wastewaters collected from different areas and other open areas which are disposed of in the tank. University is required to construct a Mini Water Filtration Tank/ recycling on the campus. This filter house is used to filter the wastewater regularly. This water is utilized for further trees and plants in the university campus as self-filtered water throughout the year.

### **6.11 Rainwater Harvesting Units**

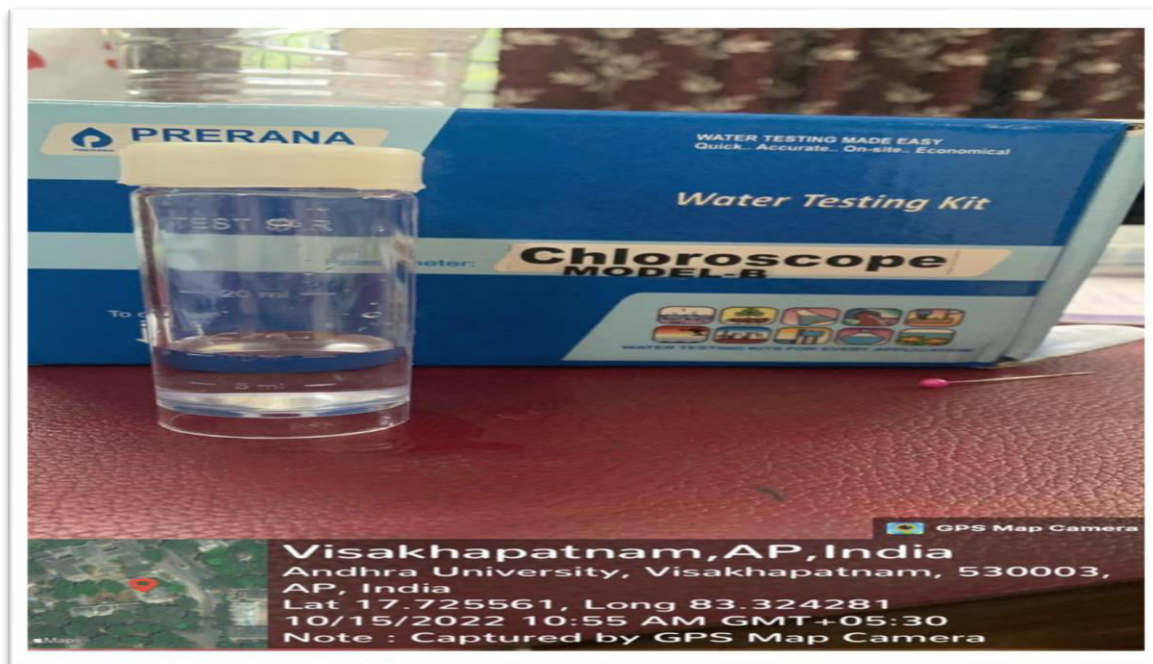
The underground water table is decreasing day by day & minute by minute. There as on is that no attempt is made to replenish the groundwater table with rainwater during the monsoon & other rainy days. Rainwater harvesting is the simple collection or storing of water through scientific techniques from the areas where the rain falls. It involves the utilization of rainwater for domestic or agricultural purposes. The method of rainwater harvesting has been in practice since ancient times. It is as far from the best possible way to conserve water and a waken society towards the importance of water. The method is simple and cost-effective too. It is especially beneficial in the areas, which face as capacity of water. We can see that the People usually make complaints about the lack of water. During the monsoons, lots of water goes waste into the gutters. And this is when Rainwater Harvesting proves to be the most effective way to conserve water. We can collect the rainwater into the tanks and prevent it from flowing in to drains and being wasted. It is practice done a large scale in metropolitan cities. Rainwater harvesting comprises the storage of water and

water recharging through the technical process. Currently, It has been informed to the audit team that for each department in North & South Campus + each Hostel is having Rain water harvesting covering 100 acres in South campus and 80 acres of North campus.

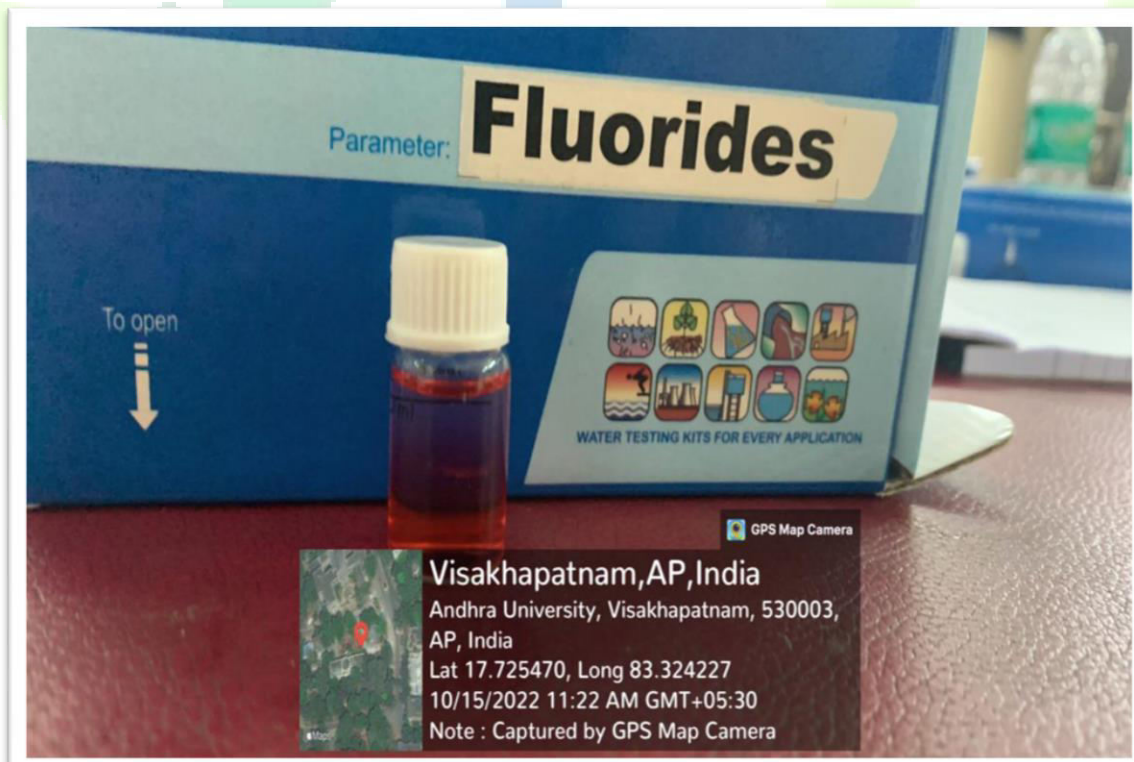


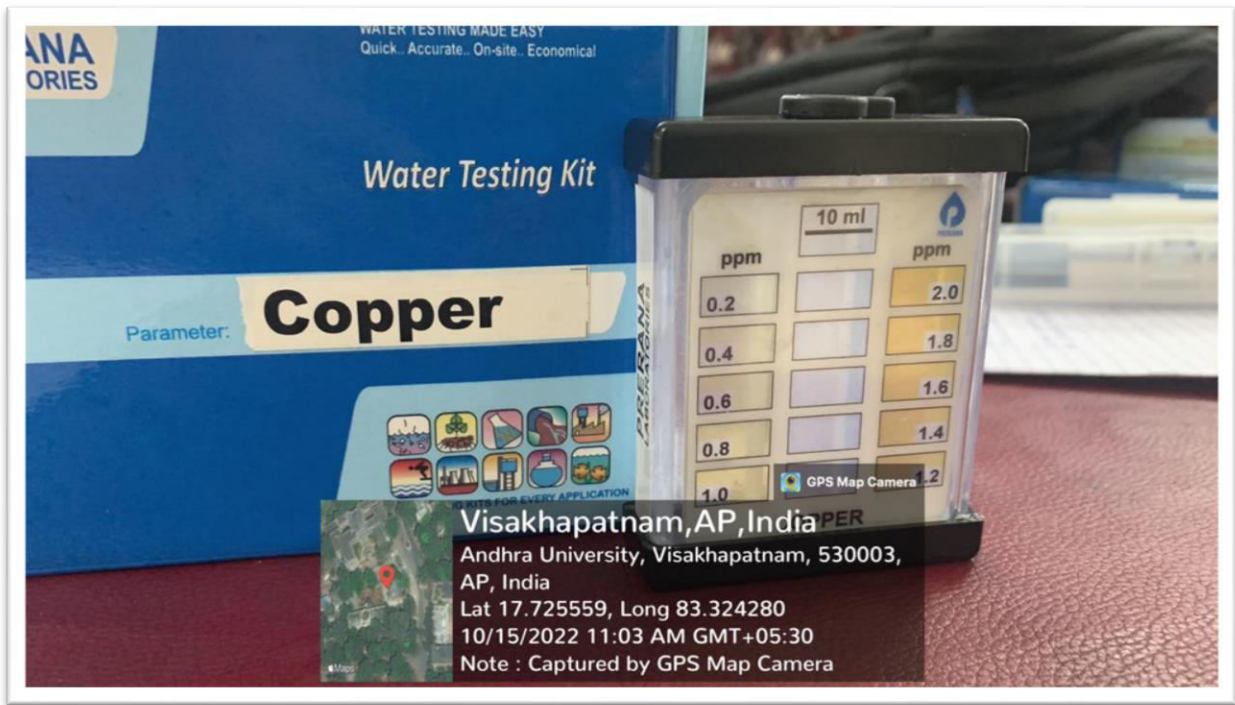
- ❖ Non-teaching staff or peons in the concerned section should take responsibility for monitoring the overflow of water tanks.
- ❖ A Large amount of water is wasted during the practical process in science laboratories. Designs of small water recycling system help to reuse of water.
- ❖ Producing distilled water in the laboratories required a large amount of water to the distillate. To produce 1 liter of distilled water required more than 33 liters of water. To avoid more wastage university should design a common distillation plant for Science Department.
- ❖ Reduce chemical waste formation in the Chemistry laboratory; adopt the principles of green chemistry to reduce chemical waste.
- ❖ Pipes, overhead tanks, and plumbing systems should be maintained properly to reduce leakages and wastages of water.
- ❖ University should install its own Sewage Treatment Plant (STP). By doing so there will be a great reduction in water usage, as the water after treatment can be used for various purposes in the University.
- ❖ As University is already having multiple units of Rainwater Harvesting Units. It will certainly add value to meet the mission of water conservation. And also help in increasing the ground water table.





## 6.12 Field Test of Quality of water





*Field test of Quality of water*

## 7.0 Waste Management

**Objectives:** The overall objectives of the waste management assessment are summarized below:

- (i) To assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated.
- (ii) To identify any potential environmental impacts from the generation of waste at the site.
- (iii) To recommend appropriate waste handling and disposal measures / routings in accordance with the current legislative and administrative requirements; and
- (iv) To categorize waste material where practicable (inert material / waste fractions) for disposal considerations i.e., public filling areas / landfill.

### **Solid Waste Management:**

To reduce waste at institute, **students and staff are educated on proper waste management practices through lectures, advertisement on notice boards, displaying slogan boards in the campus.** Waste is collected on a daily basis from various sources and is separated as dry and wet waste.

### **Campus solid waste management program**

The main objectives of SWM are the **maintenance of clean and hygienic conditions and reduction in the quantity of solid waste (SW)**, which is disposed of in the sanitary landfill facility (SLF) of the area after recovery of material and energy from it.

Student participation in waste management

**7.1 Producing less wastes:** Students can utilize their belongings like paper, pencils and pens to the maximum and produce less amounts of wastes.

2. Keeping classrooms and households clean: The students can keep their classrooms and houses clean by not littering things here and there.

Methods of disposal of solid waste management



**Here are the methods of solid waste disposal and management:**

- Solid Waste Open Burning.

- Sea dumping process.
- Solid wastes sanitary landfills.
- Incineration method.
- Composting process.
- Disposal by Ploughing into the fields.
- Disposal by hog feeding.
- Salvaging procedure.
- Benefits of waste management
- Reducing waste will not only protect the environment but will also **save on costs or reduce expenses for disposal**. In the same way, recycling and/or reusing the waste that is produced benefits the environment by lessening the need to extract resources and lowers the potential for contamination.

The 7 principles of waste management-



### The 7 R's of Recycling

- Recycle.
- Refuse.
- Reduce.
- Reuse.
- Repair.
- Re-gift.
- Recover.

## 7.2 Municipal Solid Waste

Top 3 items in municipal solid waste

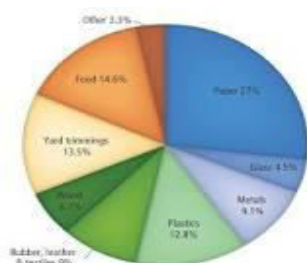
In 2018, about 146.1 million tons of MSW were land filled. Food was the largest component at about 24 percent. Plastics accounted for over 18 percent, paper and paperboard made up about 12 percent, and rubber, leather and textiles comprised over 11 percent. Other materials accounted for less than 10 percent each.





Solid Waste Management may be defined as the discipline associated with the control of generation, collection, storage, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other ...

The major sources of municipal solid waste



Municipal Solid Waste (MSW)—more commonly known as trash or garbage—consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This comes from our **homes, schools, hospitals, and businesses**.

### 7.3 Waste Management:

Objectives The overall objectives of the waste management assessment are summarized below:

- (i) To assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated.
- (ii) (ii) To identify any potential environmental impacts from the generation of waste at the site.
- (iii) To recommend appropriate waste handling and disposal measures / routings in accordance with the current legislative and administrative requirements; and
- (iii) To categories waste material where practicable (inert material / waste fractions) for disposal considerations i.e., public filling areas / landfill.

#### 7.3.1 Solid Waste Management:

To reduce waste at institute, **students and staff** are educated on proper waste management practices through lectures, advertisement on notice boards, displaying

slogan boards in the campus. Waste is collected on a daily basis from various sources and is separated as dry and wet waste.

## **7.4 Plastic Waste**

India has banned manufacture, import, stocking, distribution, sale and use of identified single use plastic items, which have low utility and high littering potential, all across the country from July 1, 2022.

Recently, the **Ministry of Environment, Forest, and Climate Change** announced the **Plastic Waste Management (Amendment) Rules, 2022**, which notified the instructions on **Extended Producer Responsibility (EPR)** for plastic packaging.

### **7.4.1 Centralized Online Portal:**

**7.4.1.1** The government has also called for **establishing a centralized online portal** by **Central Pollution Control Board (CPCB)** for the registration as well as filing of annual returns by producers, importers and brand-owners, plastic waste processors of plastic packaging waste by 31st March, 2022.

**7.4.1.2** It would act as the **single point data repository with respect to orders** and guidelines related to implementation of EPR for plastic packaging under **Plastic Waste Management Rule, 2016**.

### **7.4.2 Environmental Compensation:**

Environmental compensation will be levied based upon polluter pays principle, with respect to non-fulfillment of EPR targets by producers, importers, and brand owners, for the purpose of protecting and improving the quality of the environment and preventing, controlling, and abating environment pollution. The Polluter Pays Principle imposes liability on a person who pollutes the environment to compensate for the damage caused and return the environment to its original state regardless of the intent.

### **7.4.3 Committee to Recommend Measures:**

A committee constituted by the CPCB under the chairmanship of CPCB chairman will recommend measures to the environment ministry for effective implementation of EPR, including amendments to **Extended Producer Responsibility (EPR) guidelines**.

## **8.0 Construction & Demolition waste:**

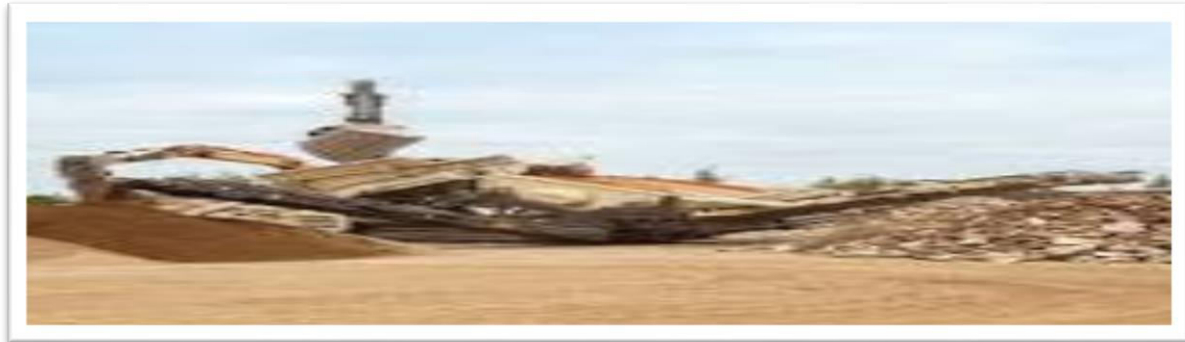
The Bureau of Indian Standards has allowed the use of concrete made from recycled material and processed C&D waste. The Construction and Demolition Waste Rules and Regulations, 2016 have mandated reuse of recycled material. Even the Swachh Bharat Mission has recognized the need for C&D waste management.

### **8.1 Construction and demolition waste management**

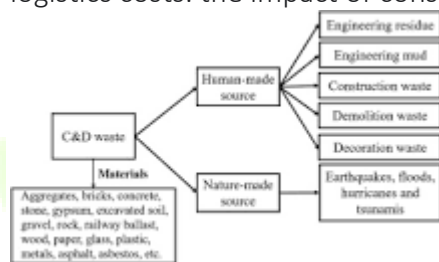
Construction and demolition waste is **generated whenever any construction/demolition activity takes place**, such as, building roads, bridges, flyover, subway, remodeling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc.

C&D waste includes bricks, tiles, stone, soil, rubble, plaster, drywall or gypsum board, wood, plumbing fixtures, non-hazardous insulating material, plastics, wallpaper, glass, metal (e.g., steel, aluminum), asphalt, etc.

## 8.2 Recycle the construction and demolition waste



Recycling construction and demolition waste is profitable and environmental way to **produce aggregates and reuse valuable materials that would otherwise be disposed**. Processing the waste near the worksites also reduces the need for truck transportation resulting in lower logistics costs. the impact of construction and demolition waste on environment.



The environmental impacts caused by C&D waste mainly include **land space consumption, landfill depletion, energy and non-energy resource consumption, resource depletion, air pollution, noise pollution, water pollution**, etc. (Akanbi et al., 2018).

## 9.0 SOLID WASTE AUDIT

Solid waste is the unwanted or useless solid material generated from human activities in a residential, industrial, or commercial area. Solid waste management reduces or eliminates the adverse impact on the environment and human health. A number of processes are involved in efficiently managing waste for an organization. It is necessary to manage the solid waste properly to reduce the load on the waste management system. Solid waste generation and its management is a burning issue in current days. The rate of generation of solid waste is very high and yet we do not have adequate technology to manage the generated waste. Unscientific handling of solid waste can create threats to public health and environmental safety issues. Thus, it is necessary to manage solid waste properly to reduce the load on the waste management system. The purpose of this audit is to find out the quantity, volume,

type, and current management practice of solid waste generation in the Andhra University campus. This report will help for further solid waste management and to go for green campus development.

### 9.1 Generation of solid waste in Andhra University

Andhra University campus solid waste data is collected from all the building areas and the same is directly handed over to the Municipalities' Bin for further segregation and recycling purpose. There are different types of waste are recorded such as paper waste, plastic waste, construction waste, glass waste, etc. However biodegradable waste is recycled through the vermicomposting process. The daily rate of waste generation has-been increasing in the recent time reaching up to an estimated amount of about 2 tons per day (tpd) during peak academic sessions and the minimum amount generated during the lean period is about 0.5 tpd.

The wastes generated in the campus include (i) kitchen wastes, (ii) wastes from construction sites, (iii) liquid waste (residential and eateries), (iv) sewage and sludge, (v) biomedical waste, (vi) laboratory chemical wastes, (vi) Plastic wastes, (vii) cans and bottles; (viii) damaged or spoiled laboratory glassware, (ix)Unused tools and machinery including battery, (xi) papers including packaging materials (xii) electronics waste (xiii) garden leaves and (xiv) sweeping litters, etc.

Proper segregation of waste can fetch more revenue to the University.

## 10 Status of solid waste generation in Andhra University Campus

SINo.	Month	Total Waste Tons/Month
1	Oct-21	33
2	Nov-21	38
3	Dec-21	26
4	Jan-22	32
5	Feb-22	41
6	Mar-22	38
7	Apr-22	39
8	May-22	29
9	Jun-22	31
10	Jul-22	46
11	Aug-22	36
12	Sep-22	42

The University is committed to ensuring that all forms of wastes generated are handled based on the RRRR (Reduce, Reuse, Recycle, Recover) principles following appropriate source segregation protocols including safe disposal of bio, medical and hazardous wastes. There are studies from time to time to estimate the amount and nature of wastes, particularly solid waste which indicates the increasing trend of the volume. A preliminary survey reveals the domination of biodegradable components (volume basis) over the non-biodegradable counterparts on the campus. The students'

hostels share the highest amount of solid waste mostly dominated by food/kitchen wastes (substantial amount of papers, plastics, metals are also seen with waste also generated in hostels) followed by residential areas, eateries including shopping complex and offices including academic buildings, construction sites (occasionally), open areas including gardens and roads.



Bricks prepared from the dry straw of rice having strength better than 1<sup>st</sup> class bricks and cost less than normal bricks. This is the most desired for Delhi as after burning the straw of rice the smog covers whole of Delhi.

## 11 E-Waste

### 11.1 Importance of e-waste management

It's critical to keep electronic waste out of landfill the EPA has stated that **e-waste is dangerous when improperly disposed of**. Electronic devices are comprised of toxic substances and heavy metals. Materials such as chromium, cadmium, mercury and lead can leach into the soil contaminating the air and waterways.

#### *Five Reasons Why E-Waste Recycling is Important*

Everyone has one. That box, drawer or shopping bag in a closet filled with old cell phones, obsolete chargers, broken tablets and defunct MP3 players. It's our personal piles of electronic waste. According to government agencies, these piles are getting bigger, forcing us to consider why e-waste recycling is important.

Recycling electronic waste (e-waste, sometimes called e-scrap has become an increasingly important environmental issue as the useful life of electronic devices becomes shorter and shorter and the list of electronic gadgets we use becomes longer and longer. E-waste recycling benefits are numerous and the need to address these items in the solid waste stream is becoming more urgent.



There are many factors to consider when evaluating electronics recycling, but here are the most significant reasons why e-waste recycling is important.

#### **11.1.1 It's critical to keep electronic waste out of landfills:**

The EPA has stated that e-waste is dangerous when improperly disposed of. Electronic devices are comprised of toxic substances and heavy metals. Materials such as chromium, cadmium, mercury and lead can leach into the soil contaminating the air and waterways. EPA estimates there are about 60 million tons of e-waste per year globally. Recycling this material will save landfill space. For these reasons, there are numerous state laws that now ban e-waste in landfills.

#### **11.1.2 Electronic products:**

*These* are comprised of valuable materials such as precious metals like gold, silver and platinum along with copper, aluminum, plastic and glass. Through the recycling process, these materials can be reclaimed. Most electronic devices are nearly 100 percent recyclable. It would be poor stewardship to landfill these materials.

#### **11.1.3 Reclaiming valuable materials:**

*Reclaiming valuable materials* from the recycling process means there will be decreased demand for new raw materials. This will help conserve important natural resources. According to the EPA, one metric ton of circuit boards contains 800 times the amount of gold mined from one metric ton of ore.

#### **11.1.4 Using recycled material:**

*Using recycled material* will also help reduce greenhouse gas emissions produced when manufacturing or processing new product known as "virgin material." The more recycled material is available, the lower the demand for virgin material.

#### **11.1.5 Discarded electronic devices:**

*Discarded electronic devices* can also be kept out of the landfill if they are refurbished, reused and donated to a worthy cause. A quick Google search will provide a list of organizations in most areas that rebuild old electronics and provide them to those who otherwise would go without. "Reuse" is an important component of keeping material out of the waste stream.

**11.1.6** *Andhra University* is planning to segregate its E - Waste for further disposal to recycler. For this they have already initiated the process. Also, in future they have agreed to file E-Waste return also.

#### **11.1.7 Single use Plastic restriction in campus Area**

From 1<sup>st</sup> July 2022, single use plastic is banned all over India. **It is expected from the University that posters and hand bills to be pasted around the campus and those who find throwing of single use plastic in campus area to be fined.** Student groups to be encouraged to take active

participation and watch and educate all that not to through such plastic in the campus area. This can be achieved through awareness and participation only. It is recommended to put slogans for NO PLASTIC ZONE or such different types of slogans. A competition among the student shall be conducted to give different suggestions for **Slogans**. The best selected Slogans to be suitably rewarded or certificate to be issued to that student. Plastics are good source of fuel also.

## **12 Hazardous Waste Management**

### **12.1 The Importance of Chemical Lab Waste Disposal for Colleges and Universities:**

To protect the safety and health of your university and its surrounding environment and community, it is required to implement proper chemical waste management. State and federal regulations require that all generators of chemical waste follow the correct disposal procedures and waste management in their facilities. Millions of dollars in fines have been leveraged against universities that do not comply with the EPA's environmental waste management procedures in United States.

#### **12.1.1 Chemical Lab Waste at Andhra University:**

The United States Environmental Protection Agency (EPA) defines chemical waste. Examples of some chemical waste material include:

- By-products created from educational and research experiments
- Surplus and unused reagent grade chemicals
- Any items that have been contaminated by chemicals
- Batteries
- Used oils
- Items containing mercury
- Pesticides
- Chemically contaminated sharps
- Contaminated needles, razor blades, pipette tips, pipettes, syringes
- Fluorescent light bulbs
- Preserved specimens
- And much more- check with your local hazardous waste disposal service for a more complete list.

#### **12.1.2 Need Proper Disposal Procedures for Chemical Lab Waste at AU University**

It is the responsibility of all of research and teaching staff to make sure the proper disposal of waste materials is followed according to EPA guidelines in United States. Irresponsible or improper disposal of your chemical waste to the local refuse collection, into the atmosphere, or down the drains is forbidden by law.

The new legislation, along with increasingly strict environmental controls, makes it essential that appropriate disposal procedures are followed to avoid stiff fines being imposed on your university. These are some of the disposal methods your university should be following:

There are some materials on the EPA's 'red list' that should never be washed down your drains:

- organohalogen, organonitrogen pesticides, triazine herbicides, or any biocides
- cyanides
- compounds with the following elements- barium, beryllium, boron, chromium, cobalt, copper, lead, mercury, nickel, silver, tin, titanium, zinc
- hydrocarbons or mineral oils
- nitrites or fluorides
- poisonous compounds, metal phosphides or phosphorus elements
- This is a partial list of chemicals- to check with local hazardous waste disposal service for a *complete list to ensure you do not pour and dangerous chemicals down the drain.*

### **12.1.3 Waste Bins and Controlled Waste Disposal**

Not abiding by the regulations and laws will lead to your university failing an inspection when the EPA, OSHA, or RCRA perform a routine examination of campus facility. If an inspection is failed, not only will it be costly, but these inspections are disruptive and can leave University with a negative reputation.

Failed inspections because of mishandled hazardous waste can add long term expenses that can occur due to noncompliance. Not correctly handling your hazardous waste can also result in staff or students being injured, as well as your insurance premiums being increased. Another disservice will inflict on the university is if not handled properly when generated, the hazardous waste can become expensive to clean up. It is much safer and economical to handle your hazardous waste disposal properly right as it is created.

Any waste suitable for local garbage services, other than glass and paper is considered controlled waste. This waste includes your dirty paper, rubber, plastic, and wood and should be placed in waste bins. Waste bins should be available in all labs and collected daily through your regular cleaning services.

Each of the labs must have a container for specific wastes that are not allowed to go with normal waste bins. In one of these special containers, should have it labeled to hold all broken lab glassware, sharp objects such as glass or metals, fine powders (which should first be placed into a glass container), dirty sample tubes, and any other contaminated chemicals that are not needles or syringes.

The lab-controlled waste containers are required to be emptied on a regular basis and should never be allowed to overflow. It should never be allowed to place any glass, fine powder, or sharp metal into a standard lab waste bin. Before placing bottles into the waste container, remove their tops, and make sure there is no detectable smell of chemicals coming from the bottles.

### **12.1.4 Risks of Improperly Handled Lab Waste**

Exposure to toxic chemicals, reactions, explosions, fires, or spills is all possible risks when the chemical wastes are not disposed of and handled properly. These possible situations pose threats to staff and students as well as other people in the area.



People's lives can be at risk, or the possibility of serious injuries is present from not complying with state and federal laws when it comes to managing your university's hazardous waste. University administration should check with local hazardous waste disposal service, which is authorized to move and touch lab waste in a manner that minimizes potential risks to your staff and students.

### *12.1.5 Environmental Hazards from Improperly Handled Lab Waste*

Students and staff members are not the only one's subject to risks from mishandled lab waste. The environment can also suffer serious consequences. Leachate, contamination, and pollution are all negative effects from hazardous waste, and will seriously leave a mark on the environment if University does not handle them properly.

When waste from the labs is eventually removed from the facility, it not only affects individuals such as staff and students, but it can also ultimately affect society as a whole. **Lab waste is disposed of through three routes: into the atmosphere through gaseous effluent from incineration or evaporation, into our oceans, rivers, or other waterways through sewer systems and wastewater treatment facilities, and finally into landfills.**

In labs, the workers who are generating lab waste have an obligation to consider the fate of their used materials that they've created from their work. The lab workers need to be aware of the significant impact their disposal materials will have to people outside the lab, and how they will affect the environment around university and the surrounding community.



### *12.1.6 Workers Impact Proper Lab Waste Disposal*

Materials become a waste by regulatory definition or a generator's decision, and the first responsibility for it being properly disposed of is in the hands of the lab worker. These workers are in the best place to know the characteristics of the materials they have synthesized or used. It is the lab worker's responsibility to assess the risks associated with the waste and evaluate it. It is the lab worker's choice on which strategy to handle; they must minimize or dispose of lab waste.

Lab workers have numerous sources available to them to help with making the decision on how to dispose of their lab waste. It can also have them check with the local hazardous waste disposal service for guidance on how to properly dispose of dangerous lab wastes.

### *12.1.7 Risk of Serious Injuries from Mismanaged Lab Waste in Universities*

The EPA has discovered forgotten chemicals in university stockrooms through routine inspections of their laboratories. They have located a pattern of hazardous waste management problems in these research labs with their wastes being left, sometimes for decades, in damaged containers. Some of these containers are even labeled as 'unknown' and some chemicals have been kept in temperatures that could cause them to explode.

Laboratories in universities and medical research centers use a large variety of chemicals that perform an extensive range of work. If labs in university are not managed properly, they will

endanger both the workers in the lab and the community surrounding your University. The most serious problems these mishandled lab wastes can inflict include death.

To improve chemical lab waste management, the EPA (Environmental Protection Agency) created outlines on how to properly dispose of these hazardous materials through the RCRA (Resource Conservation and Recovery Act.) They have also created workshops, encouraged self-auditing of university labs, provide compliance assistance, and in some cases, taken enforcement actions.

In one case involving the University of California, the EPA located numerous violations of hazardous waste requirements, many of which the University disclosed on their own accord. The violations were stated to include more than 4,000 containers of hazardous lab waste. Some of these wastes included reactive cyanide, corrosive acid, ignitable paint, and photochemical waste.

It was reported that the university had to spend almost two million dollars and over 23,000 staff hours to complete environmental audits in forty-seven of their university facilities, their agricultural research stations, campuses, medical and vet schools, and other various facilities. The EPA did reduce the penalties for many of the violations when the university agreed to Incentives for Self-Policing.

It can now see the importance of proper chemical lab waste disposal at your university. Proper handling will save facility millions of dollars trying to correct mismanagement if it is discovered by the EPA. When you routinely follow proper management, you will have no concerns when it's time for an audit of university.

It will not only save individuals and university unnecessary expenses; one will protect the soil, air, wildlife health, and water in environment and that of the surrounding community. Regulations to dispose of lab waste properly exist to help one know how to handle your hazardous chemicals. If anyone is unsure which procedures apply to the materials in university lab, contact the local hazardous waste disposal service, and they will help. This service can come into lab and show how to label store, and dispose of all lab waste safely and properly.

The management of hazardous waste is a **process which includes the collection, recycling, treatment, transportation, disposal, and monitoring of wastes disposal sites.** In the current scenario of developing countries, hazardous wastes are often disposed directly into the environment posing health and environmental risk.

### **12.1.8 Responsibilities**

- Hazardous-waste characteristics.
- Transport of hazardous waste. Transport vehicles. The manifest system.
- Treatment, storage, and disposal. Treatment. Surface storage and land disposal. Secure landfills.
- Remedial action.

### **12.1.9 Procedure**

- Hazardous waste can be treated by **chemical, thermal, biological, and physical methods**. Chemical methods include ion exchange, precipitation, oxidation and reduction, and neutralization. Among thermal methods is high-temperature incineration, which not only can detoxify certain organic wastes but also can destroy them.

### 12.1.10 Objectives

- Hazardous Waste Management Rules are notified to ensure safe handling, generation, processing, treatment, package, storage, transportation, use reprocessing, collection, conversion, and offering for sale, destruction and disposal of Hazardous Waste.

## 12.2 Practice adopted in India

- **Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016**  
Responsibilities of the occupier for management of hazardous and other wastes. -  
(1) For the management of hazardous and other wastes, an occupier shall follow the following steps, namely: -(a) prevention; (b) minimization; (c) reuse, (d) recycling; (e) recovery, utilization including co-processing; (f) safe disposal.  
(2) The occupier shall be responsible for safe and environmentally sound management of hazardous and other wastes.  
(3) The hazardous and other wastes generated in the establishment of an occupier shall be sent or sold to an authorized actual user or shall be disposed of in an authorized disposal facility.  
(4) The hazardous and other wastes shall be transported from an occupier's establishment to an authorized actual user or to an authorized disposal facility in accordance with the provisions of these rules.  
(5) The occupier who intends to get its hazardous and other wastes treated and disposed of by the operator of a treatment, storage and disposal facility shall give to the operator of that facility, such specific information as may be needed for safe storage and disposal.  
(6) The occupier shall take all the steps while managing hazardous and other wastes to- 5 (a) contain contaminants and prevent accidents and limit their consequences on human beings and the environment; and (b) provide persons working in the site with appropriate training, equipment, and the information necessary to ensure their safety.

Grant of authorization for managing hazardous and other wastes. -

- (1) Every occupier of the facility who is engaged in handling, generation, collection, storage, packaging, transportation, use, treatment, processing, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other wastes shall be required to make an application in Form 1 to the State Pollution Control Board and obtain an authorization from the State Pollution Control Board within a period of sixty days from the date of publication of these rules. Such application for authorization shall be accompanied with a copy each of the following documents, namely: -  
(a) consent to establish granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981);

(b) Consent to operate granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and/or Air (Prevention and Control of Pollution) Act, 1981, (21 of 1981).

(c) in case of renewal of authorization, a self-certified compliance report in respect of effluent, emission standards and the conditions specified in the authorization for hazardous and other wastes: Provided that an application for renewal of authorization may be made three months before the expiry of such authorization: Provided further that-

(i) any person authorized under the provisions of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, prior to the date of commencement 6 (ii) of these rules, shall not be required to make an application for authorization till the period of expiry of such authorization; any person engaged in recycling or reprocessing of the hazardous waste specified in Schedule IV and having registration under the provisions of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, shall not be required to make an application for authorization till the period of expiry of such registration.

(2) On receipt of an application complete in all respects for the authorization, the State Pollution Control Board may, after such inquiry as it considers necessary, and on being satisfied that the applicant possesses appropriate facilities for collection, storage, packaging, transportation, treatment, processing, use, destruction, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other waste, as the case may be, and after ensuring technical capabilities and equipment complying with the standard operating procedure or other guidelines specified by the Central Pollution Control Board from time to time and through site inspection, grant within a period of one hundred and twenty days, an authorization in Form 2 to the applicant, which shall be valid for a period of five years subject to such conditions as may be laid down therein. For commonly recyclable hazardous waste as given in Schedule IV, the guidelines already prepared by the Central Pollution Control Board shall be followed: Provided that in the case of an application for renewal of authorization, the State Pollution Control Board may, before granting such authorization, satisfy itself that there has been no violation of the conditions specified in the authorization earlier granted by it and same shall be recorded in the inspection report.

(3) The authorization granted by the State Pollution Control Board under sub-rule (2) shall be accompanied by a copy of the field inspection report signed by that Board indicating the adequacy of facilities for collection, storage, packaging, transportation, treatment, processing, use, destruction, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other wastes and compliance to the guidelines or standard operating procedures specified by the Central Pollution Control Board from time to time.

(4) The State Pollution Control Board may, for the reasons to be recorded in writing and after giving reasonable opportunity of being heard to the applicant, refuse to grant any authorization under these rules.

(5) Every occupier authorized under these rules, **shall maintain a record of hazardous and other wastes managed by him in Form 3** and prepare and submit to **the State Pollution Control Board, an annual return containing the details specified in Form 4 on or before the 30th day of June** following the financial year to which that return relates.

(6) The State Pollution Control Board shall maintain a register containing particulars of the conditions imposed under these rules for management of hazardous and other

wastes and it shall be open for inspection during office hours to any interested or affected person.

(7) The authorized actual user of hazardous and other wastes shall maintain records of hazardous and other wastes purchased in a passbook issued by the State Pollution Control Board along with the authorization.

(8) Handing over of the hazardous and other wastes to the authorized actual user shall be only after making the entry into the passbook of the actual user.

Storage of hazardous and other wastes. - (1) The occupiers of facilities may store the hazardous and other wastes for a period not exceeding ninety days and shall maintain a record of sale, transfer, storage, recycling, recovery, pre-processing, co-processing and utilization of such wastes and make these records available for inspection: **Provided that the State Pollution Control Board may extend the said period of ninety days** in following cases, namely: - (i) (ii) (iii) (iv) (v)

9. small generators (up to ten tons per annum) up to one hundred and eighty days of their annual capacity; actual users and disposal facility operators up to one hundred and eighty days of their annual capacity, occupiers who do not have access to any treatment, storage, disposal facility in the concerned State; or the waste which needs to be specifically stored for development of a process for its recycling, recovery, pre-processing, co-processing or utilization; in any other case, on justifiable grounds up to one hundred and eighty days.

### **TREATMENT, STORAGE AND DISPOSAL FACILITY FOR HAZARDOUS AND OTHER WASTES**

16. Treatment, storage and disposal facility for hazardous and other wastes. -

(1) The State Government, occupier, operator of a facility or any association of occupiers shall individually or jointly or severally be responsible for identification of sites for establishing the facility for treatment, storage and disposal of the hazardous and other waste in the State.

(2) The operator of common facility or occupier of a captive facility shall design and set up the treatment, storage and disposal facility as per technical guidelines issued by the Central Pollution Control Board in this regard from time to time and shall obtain approval from the State Pollution Control Board for design and layout in this regard.

(3) The State Pollution Control Board shall monitor the setting up and operation of the common or captive treatment, storage and disposal facility, regularly.

(4) The operator of common facility or occupier of a captive facility shall be responsible for safe and environmentally sound operation of the facility and its closure and post closure phase, as per guidelines or standard operating procedures issued by the Central Pollution Control Board from time to time.

(5) The operator of common facility or occupier of a captive facility shall maintain records of hazardous and other wastes handled by him in Form 3.

(6) **The operator of common facility or occupier of a captive facility shall file an annual return in Form 4 to the State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates.**

## Acid from Labs

### 12.3 Disposal of Acid in a Lab:

Some of these methods are:

- (a) Recycling/reuse of the chemicals.
- (b) Incineration and disposal in landfills of incineration ash;
- (c) Disposal in landfills of stabilized chemical waste, or non-hazardous waste; and
- (d) Disposal in sewers of neutralized, non-toxic chemicals.

#### 12.3.1 How to dispose of acid solutions

Carefully pour one-quarter to one-half-cup of the hydrochloric acid into 2 to 5 gallons of water. It's very important to always add the chemical to the water and not the water to the chemical. **Pour the diluted solution down the sink, flushing with large amounts of water.** Work slowly to avoid splashes.

#### 12.3.2 4 Types of waste generated from a lab

This waste can be broken down into a number of categories: **Hazardous; Clinical; Biological; Electrical; Laboratory.** Reducing laboratory waste will have a number of benefits, saving money and reducing disposal costs while also encouraging safety in the lab.

#### 12.3.3 Handling and disposal of laboratory waste

##### *Waste disposal - disposal of laboratory wastes (guidance)*

1. Disposal Procedures.
2. Wash Down Drains with Excess Water.
3. Incineration.
4. Laboratory Waste Bins and Controlled Waste.
5. Waste for Special Disposal.
6. Glass Recycling.
7. Bottles for Bulk Solvents.
8. Biohazard/Sharps Disposal - Syringes and Needles.

#### 12.3.4 Types of laboratory waste

- Clinical laboratories generate three primary types of waste: **chemical waste, infectious (biohazard) waste, and pathological (large tissue) waste.** This section contains

information on correct disposal as well as environmental best practice for managing laboratory wastes.

- **Dispose of sulfuric acid in a lab**
- Sulfuric acid may also be diluted and then neutralized. One method of neutralization is to add the acid slowly to a solution of soda ash and slaked lime, and to then flush with a large volume of water. Once sulfuric acid is diluted and neutralized it can be **discharged to a sewer**.
- **Neutralizing HCl in disposal**
- Decontamination/Waste Disposal Procedure Spills may be neutralized with **sodium bicarbonate or baking soda**. Do not dispose of HCl by pouring down drains followed by copious amounts of water without neutralization.

## *12.4 Disposal of proper chemical hazardous waste in the laboratory*

### *12.4.1 Caps and closure:*

1. Use waste containers with leak-proof, screw-on caps so contents can't leak if a container tips over. ...
2. If necessary, transfer waste material to a container that can be securely closed. ...
3. Keep waste containers closed except when adding waste.
4. Wipe down containers prior to your scheduled collection date.

### *12.4.2 Responsibilities*

- Hazardous-waste characteristics.
- Transport of hazardous waste. Transport vehicles. The manifest system.
- Treatment, storage, and disposal. Treatment. Surface storage and land disposal. Secure landfills.
- Remedial action.

## 13 Bio-Medical Waste

There are generally 4 different kinds of medical waste: **infectious, hazardous, radioactive, and general**

### *Types of Bio-medical waste*

- Human anatomical waste like tissues, organs and body parts.
- Animal wastes generated during research from veterinary hospitals.
- Microbiology and biotechnology wastes.
- Waste sharps like hypodermic needles, syringes, scalpels and broken glass.
- Discarded medicines and cytotoxic drugs.
- What is the rule of bio-medical waste?
- Amendments in Bio-Medical Waste Management Rules, 2016 Rules. The amended rules stipulate that generator of bio-medical waste such as hospitals, nursing homes, clinics, and dispensaries etc. will not use chlorinated plastic bags and gloves beyond March 27, 2019, in medical applications to save the environment.
- Who is responsible for biomedical waste management?
- The responsibility of each state to check for compliance will be done by setting up **district-level committee under the chairpersonship of District Collector or District Magistrate or Additional District Magistrate**. In addition, every 6 months, this committee shall submit its report to the State Pollution Control Board.
- Biomedical waste management is important
- Biomedical waste management is of great significance because **biomedical waste can adversely affect health inviting serious implications to the people who get in touch with it**. Segregation, storage and safe disposal of the waste is the key to the effective management of biomedical waste in a workplace



## 14 Fire Fighting

Every educational institution must have a minimum of two staircases, two fire extinguishers on each floor and manually operated fire alarm call points on each floor. Every classroom that can seat more than 45 students must have two exits and fire drills should be conducted once in six months.

### 14.1 Fire safety norms in India

Height shall be a fire tower and in such a case width of the same shall not be less than the width of the main staircase. No combustible material shall be allowed in the fire tower. a) The use of spiral staircase shall be limited to low occupant load and to a building height 9 m.

#### 14.1.1 Measures to assess fire safety



Fire safety is a fundamental consideration in building design and management, but unfortunately, one that is often overlooked. Firewalls are today more likely to be associated with IT security than with physical safety.



Assess fire safety measures in your built environment with the help of this checklist.

#### 14.1.2 Provide adequate means of escape

The first rule of fire management requires sufficient escape routes out of the building, in accordance with its scale and occupancy. The number, size and location of exits are specified in the National Building Code (NBC) 2005, a detailed set of guidelines for constructing, maintaining and operating buildings of all types. Office occupiers must additionally ensure that staircases, stairwells and corridors are well-maintained, ventilated and free of obstacles in order to be effective in an emergency.

Open spaces in buildings play a crucial role in fire management. As P.D. Karguppikar, joint chief fire officer of the Mumbai Fire Brigade, remarked after the terrorist attacks on 26/11: "The atrium in the old wing of the Taj (hotel) allowed heat to dissipate, and prevented collateral damage to other floors from the fire on the sixth floor."

#### ***14.1.3 Outline clear pathways to exit doors***

Getting to exits is as important as providing enough exits. NBC guidelines specify the maximum distance a person must travel in order to access a fire exit, and the importance of photo-luminescent signage to enable evacuation at night. Refuge areas such as terraces are critical for high-rises where people can safely congregate, when asked to leave the building in phases.

#### ***14.1.4 Install smoke detection systems***

The first few minutes of a fire are crucial in containing it. Automatic fire alarm systems such as smoke and heat detectors are mandatory elements in international building codes, and particularly useful in spotting fires during times when occupancy in the building is low.

#### ***14.1.5 Maintain smoke suppression systems***

Fire extinguishers are only useful if they work, so check them regularly. High-rise buildings, which are harder to access and evacuate, should consider installing automatic sprinkler systems. The National Fire Protection Association (NFPA), a US-based non-profit body, estimates that automatic suppression systems lower the cost of damage by 60%. Karguppikar endorses their use, admitting that "the fire in one of the rooms on the 18th floor of the Oberoi was extinguished by its sprinkler system and it was an eye-opener for all of us".

#### ***14.1.6 Conduct regular fire drills***

Preventing panic in an emergency is as important as staying away from flames and fumes. Regular fire drills familiarize people with emergency evacuation methods at little cost. Nominate a fire safety officer in every building to ensure that this becomes standard operating procedure.

#### ***14.1.7 Use flame-retardant materials in interiors***

Materials used in the interiors can save or endanger lives. The combination of wood, paper and textiles makes workstations highly combustible. Fabrics can be made flame-retardant, however, so that they self-extinguish when lit. An increasing number of companies, especially multinationals, request such fabrics despite their price premium, according to data from Indian office furniture manufacturer BP Ergo. Stringent fire regulations abroad make it necessary for US furniture makers such as Herman Miller to provide only fire-tested fabrics.

Doors are also assigned a fire-resistance rating, measuring how long they can remain resistant to excessive temperatures and flames without collapsing. Karguppikar lauds the construction of the fire-treated doors in the Taj, which allowed several rooms to stay insulated for hours despite a raging fire just outside.

#### ***14.1.8 Make office accessible to firefighters***

Grilled windows are a widespread urban phenomenon, and Jairaj Phatak, commissioner, Brihanmumbai Municipal Corporation (BMC), wittily observes that “residents who have grills on their windows presume that only thieves are kept out, and not firefighters”. Occupants of offices in residential buildings with few exits should be wary of locking themselves into confined spaces.

#### **14.1.9 Keep the building plans handy**

The tragedy at the Taj was heightened by the lack of buildings plans to guide rescue agencies. It is imperative to make multiple copies of your building plan available, especially during an emergency.

#### **14.1.10 Ask the local fire brigade to assess safety**

Fire departments, for a nominal fee, will independently assess your building’s level of fire safety. Storage of hazardous or inflammable materials, old and unstable structures, inadequate escape routes or electricity overloads are potential death traps that are best assessed by professionals.

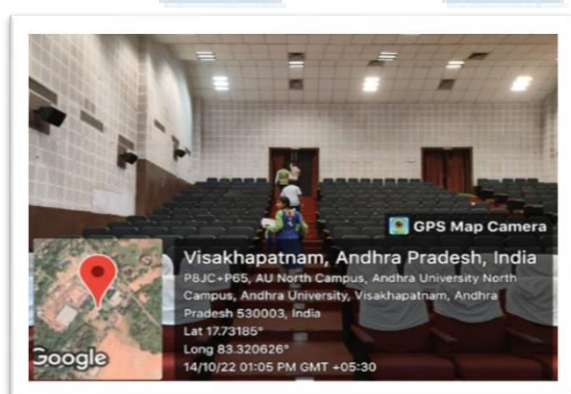
#### **14.1.11 Comply with National Building Code**

“Green buildings” are in vogue, but safe structures are sadly not. Both the Mumbai Fire Brigade and BMC commissioner concede that 80% of buildings likely violate accepted codes of building safety, with ignorance and personal whims leading to illegal modifications after gaining requisite occupancy permission.

At AU campus different locations fire safety devices were checked and it was found that proper refilling date, next filling date were mentioned on the device. Staff nearby were asked about operation, and it was found they were more or less acquainted with the operation of the firefighting devices. It is recommended to hold a fire safety drill once a year so that a proper awareness should be there among the staff and the students.



Fire Fighting buckets at different locations



Dr. Y. V. S Murthy Hall



Fire Fighting Equipments at different locations with UpToDate refilling, testing and next due dates

*NOTE: Firefighting equipments at various halls including Dr Y. V. S Murty hall need to be checked for adequacy.*

## 15 ENERGY AUDIT

Energy is one of the major inputs for the economic development of any country. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. Also, it can be said as “the strategy of adjusting and optimizing energy, using system and procedure so as to reduce energy requirements per unit of output while holding constant or reducing total costs producing the output from these systems”. The energy audit is key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy inputs with its use and serves to identify all the energy streams in a facility. The present policy of Government of India is to achieve Net Zero. All out efforts have been planned. Andhra University has done a lot towards green renewable energy. Mostly the campus is harvesting Solar energy. As discussed with the eminent professors, it was informed that sooner they are planning to harvest energy from wind energy also. Being located near the seashore, it has got a good potential of wind energy. Andhra University is committed to achieve the goal of becoming net zero policy.

### 15.1 Resource Energy Audit

Energy resources utilized by all the departments, support services, and the administrative buildings of Andhra University, include Electricity, Solar Roof Top Systems, and Diesel Generators installed on the campus.

## 15.2 Energy Audit Objective

### 15.2.1 Primary

- The first objective is to acquire and analyze data and find the necessary consumption pattern of the facilities.
- The second objective will be to calculate the wastage pattern based on the results of the first objective.
- The final objective is to find and implement solutions that are acceptable and feasible.

### 15.2.2 Secondary

15.2.2.1 This would be our first exposure to this field hence experience gain would be vital.

15.2.2.2 This project will follow many follow up projects and hence helps to gain technical and management exposure required for future energy projects.

15.2.2.3 It is sure to help create vital contact hence will develop interaction with alumni, faculty and students.

## 15.3 Source of Energy

Total power requirement for college 3,42,547.52KW for month. Presently Chemical Engineering department is having Solar panel roof top of Capacity 60kWh whereas the total need of Chemical Engineering department at peak hours is 120 kWh. At many instances they generate electricity and send it to grid in place of taking electricity from the grid. In the similar way, University has planned stagewise provision of all rooftops with solar Energy. In addition, it has also been planned to harvest wind energy. Andhra University, Vishakhapatnam, withdraws Energy from Followings:

15.3.1 Electricity from APDCL

15.3.2 Solar Energy

The Following are the Major consumers of electricity in the facility

15.3.3 Lightning

15.3.4 Air Conditioner

15.3.5 Fans

15.3.6 Computers

15.3.7 Other Lab Equipment

## 15.4 Indirect Benefits of Energy Audit

Every time the Energy Audit is carried out it rekindles the interest in Energy Conservation as an important function. Energy Auditors sharing their experience

and knowledge with the Plant Personnel helps in fueling the innovative ideas for further action of reduction in Specific Power consumption (SPC). Any loose connections or heating of cables come to timely vision. For a next unbiased vision, a few points for Energy Conservation may be visible each time when perform the audit and this would help in achieving further saving. Inform any irregularities in Energy meter HT connections for rectification.

## TOTAL POWER REQUIREMENT OF VARIOUS DEPARTMENT

Sr. No.	NAME OF THE DEPARTMENT	CFL	TUBELIGHTS		FANS	AIR_CONDITIONER			PROJECT	STREET LIGHT LED
			CFLT\L	LED / ceiling light		1Ton	1.5Ton	2Ton		
1	LAW COLLEGE	19	179	100	170					
2	BULDING1 PHARMACY	174	102	40	94		9			
3	BULDING2 PHARMACY	2	40	40	28	3	3			
4	BULDING3 PHARMACY		115	80	57	1	7	2		
5	LIBRARY		153	50	69			2		
6	PHYSICS		177	60	119		8			
7	YOGA DEPARTMENT	66	109	70	105					
8	DEPARTMENT OF TELUGU		58		25	1				
9	DEPARTMENT OF PSYCHOLOGY AND PARAPSYCHOLOGY	28	164		99	9	5			
10	ACADEMICCELL	55	90	20	61					
11	CAOBLOCK	142	242	50	167		8	2		

12	GEOGRAPHY	2	55	10	35		3			
13	RANJINI GUEST HOUSE	24	136	5	99		5			
14	FINE ARTS		220		50		10			
15	MLR DEPARTMENT		166		108	1	2			
16	WOMEN ENGINEERING	21	52	50	50					
17	SERVER ROOM	42	185		92		2			
18	OSTC	10	89		21		4			
19	CONTROL SYSTEMS LAB	82	280		102		4			
20	WORKSHOP BUILDING		43	76	56					
21	STATISTICS AND MATHEMATICS	5	101	71			5			
22	APPLIED MATHEMATICS	4	68		39		4			
23	POPULATION DEPARTMENT	2	31	18			7			
24	ASOKHAVARDANA HOST	44	1001		748					
25	BIOCHEMISTRY	1	124		60			6		
26	BIOTECHNOLOGY	35	153		104	4				
27	MICROBIOLOGY DEPART	56	163		102		6			
28	MUSIC DEPARTMENT	49	146		120		1	4		
29	HUMAN GENETICS/RLNL		95	50	108	7	4			
30	PGHOSTELS	98	607		525					
31	SCIENCEPRINCIPAL OFFIC	26	73	44	47	21	1	3		
32	ZOOLOGY	30	297		141		6	3		
33	ANALYTICAL CHEMISTRY	10	16		15	1	12	6		

34	FOOD AND NUTRITION	4	10		12				
35	CHEMICAL ENGINEERING	2	166		119		2		
36	DRAWING HALL	10	310	30	181		8		
37	CHEMICAL LPG BUILDING		152		77		14		
38	CIVIL ENGINEERING DEPARTMENT	28	90		67		14		
39	ELECTRICAL ENGINEERING DEPARTMENT		82	43	51		12		
40	ELECTRICAL LAB BLOCK		72		50				
41	METAL LURGY		148		94		12		
42	TRAINING AND PLACEMENT OFFICE	14	22		14		10		
43	MARINE ENGINEERING		205	30	89		15		
44	GEOLOGY	31	310	9	112	1	10		
45	INTERNATIONAL STUDENTS HOSTEL	192	262	20	129		9		
46	GEO ENGINEERING		74		40		11		
47	ECE	9	568	30	317				
48	MECHANICAL		366	21	192		10		
49	LIBRARY	12	33		56		13		
50	DEPARTMENT OF MUSIC		61		40				
51	JOURNALISM AND MASS COMMUNICATION	13	59		44		6		



52	SOCIAL EXCLUSION AND INCLUSION POLICY	8	35		15		1			
53	THEATRE OF ARTS		32		32					
54	DEPARTMENT OF WOMEN STUDIES		60		34		5			
55	COMMERCE AND MANAGEMENT ANNEXURE BUILDING		122		73		3			
56	PRINCIPAL COLLEGE OF ARTS AND COMMERCE	19	77		62		15			
57	DEPT OF POLITICAL SCIENCE	2	92		86		5			
58	DEPT OF ANTHROPOLOGY	94	664	10	380		26			
59	DEPT OF GURUKULAM	48	74		58					
60	INNORGANIC DEPT	44	197		78		14			
61	Examination			150	100		5			
62	Innovation Center			150			25			
63	Pipe			100			20			
65	CIVIL ENGINEERING COMPLEX			50	20					
66	SAARC CENTRE			100	50					
67	SAGIRIKA FUNCTION HALL			100		80				
68	CONVENTION HALL			200		200				
	Total	1557	9873	1877	6288	329	372	37		900
	Total Consumed for hour In Watts	18	40	22	60	1424	2136	2848		60

Total Load Consumed for 5 hours	140130	1974600	206470	1886400	2342480	3972960	526880		270000
Total Load Consumed for Month	4344030	61212600	6400570	58478400	72616880	123161760	16333280		342547.52

**Total power requirement for college 342547.52 KW for month**

*Note: Andhra University Authorities committed, that it will convert all CFL light sin LED tube lights*

As per the future policy, AU is committed to convert all CFL into LED and they are already in a mode to purchase all electrical appliances star rated in future purchase. Hence forth all electrical appliances which are being purchased are all-star rated.

### 15.5 Observation

The proposed retail supply tariff by Discoms for the financial year 2022-23 has created confusion among people and there are apprehensions about the possible hike in power tariff.

Discoms maintain that the proposed tariff will not be a burden for the poor. *However, there was no explanation as to why the proposals have been split into two groups — one from April 1 to July 31, 2022, and second from August 1, 2022 to March 31, 2023.*

Three Discoms — APEPDCL, APSPDCL, APCPDCL — have proposed to restructure the existing domestic consumer categories from August 2022. At present, there are three categories — Group A: Consumption from 0-75 units during the billing month (0-50 units; 51-75 units), Group B: Consumption of power more than 75 units and less than 225 units during the billing month (0-100 units; 101-200 units; 201-225 units), and Group C: Consumption above 225 units in a billing month (0-50 units; 51-100 units; 101-200 units; 201-300 units; 301 to 400 units, 401 to 500 units and above 500 units.)

It has been restructured by merging B and C groups and new power tariffs for the same have been fixed, applicable from August 1 next year. Further in Group 1, sub-classes have also been changed.

The restructure categories will be Group A: consumption from 0-75 units during the billing month (0-30 units; 31-75 units), Group B: consumption of power more than 75 units during the billing month (0-100 units; 101-200 units; 201-300 and above 300 units)

As per the proposals from April 1 to July 31, 2022, unit cost will be Rs 1.45 for those consuming less than 50 units, Rs 2.60 per unit for those consuming between 51 to 75. Once the consumption crosses 75 units, the consumer will be categorized in Group B and the tariff would be Rs 2.60 per unit for power consumed between 0 and 100 units, Rs 3.60 per unit for power consumed between 101 and 200 units, Rs 6.90 per unit for power consumed between 201 and 225 units.

If the power consumption is more than 225 units in a billing month, the consumer is categorized into Group C and the tariff will be Rs 2.65 per unit for the first 50 units consumed, Rs 3.35 per unit for 51 to 100 units, Rs 5.40 per unit for 101 to 200 units, Rs 7.10 per unit for 201-300 units, Rs 7.95 per unit for 301 to 400, Rs 8.50 per unit for 401 to 500 units and Rs 9.95 per unit for above 500 units.

As per the proposed tariff for August 1, 2022, to March 31, 2023, unit cost will be Rs 1.45 for those consuming less than 30 units, Rs 2.80 per unit for those consuming between 31 to 75.

Once the consumption crosses 75 units, the consumer will be categorized in Group B and the tariff would be Rs 4 per unit for power consumed between 0 and 100 units, Rs 5 per unit for power consumed between 101 and 200 units, Rs 7 per unit for power consumed between 201 and 300 units, and Rs 7.50 per unit for power consumed above 300 units.

Experts told TNIE that going by the proposed tariff from August 2022, the additional burden is expected to be around Rs 100 crore per month.

“No official is explaining the rationale behind the proposed two types of tariff for the next fiscal. There is one type of tariff in categorization in the first four months and another tariff and categorization for the subsequent eight months. Further, what is the rationale behind changing the sub-category from 0-50 units to 0-30 units in Group A. How many consumers are there in the 0-30 unit’s category,” questioned CPM leader Ch Babu Rao.

Energy department officials said not much burden has been put on the consumer and there would only be a 20 paise increase in tariff for 51-75 units. But they are tight-lipped about the proposed power tariff from August 2022.

Energy department officials say that it is only a proposal, and the final call will be taken by the APERC after considering the objections from the consumers. Further, they claim Andhra Pradesh is very less compared to power charges in other states and national average.

Three categories at present		SIMPLY PUT		Proposed tariff for August 1 2022 to March 31, 2023				
<b>Group A</b> consumption from 0-75 units	Unit cost will be ₹1.45 for those consuming less than 50 units, ₹2.60 per unit for those consuming between 51 to 75. Once the consumption crosses 75 units, the consumer will be categorised in Group B and the tariff would be ₹2.60 per unit for 0-100 units, ₹3.60 per unit for power consumed between 101 and 200 units, ₹6.90 per unit for power consumed between 201 and 225 units	₹1.45 per unit for those consuming less than 30 units	₹2.80 per unit for those consuming between 31 to 75	Once the consumption crosses 75 units, the consumer will be categorised in Group B				
<b>Group B</b> consumption of power more than 75 units								
<b>Group C</b> Consumption above 225 units								
<b>NEW CATEGORIES</b>	<b>Group A</b> consumption from 0-75 units	<b>Group B</b> consumption above 5 units	<table border="1"> <tr> <td>₹4 a unit: 0 to 100 units</td> <td>₹5 per unit: 101 and 200 units</td> <td>₹7 per unit: 201 and 300 units</td> </tr> </table>			₹4 a unit: 0 to 100 units	₹5 per unit: 101 and 200 units	₹7 per unit: 201 and 300 units
₹4 a unit: 0 to 100 units	₹5 per unit: 101 and 200 units	₹7 per unit: 201 and 300 units						
			<table border="1"> <tr> <td colspan="3">₹7.50 per unit above 300 unit</td> </tr> </table>			₹7.50 per unit above 300 unit		
₹7.50 per unit above 300 unit								

### 15.6 Lighting system

Lighting is an essential service in all industries, Universities, Hospitals, Malls, etc. Innovation and continuous improvement in the field of lighting, have

given rise to tremendous energy-saving opportunities in this area. Lighting is an area, which provides some major scope to achieve energy efficiency at the design stage, by incorporation of modern energy-efficient lamps, luminaries, and gears, apart from good operational practices.

*Basic Terms in Lighting System and Features:*

## **Lamps**

Lamp is equipment, which produces light. The most commonly used lamps are

Described briefly as follows:

### **Incandescent lamps**

Incandescent lamps produce light by means of a filament heated to incandescence by the flow of electric current through it. The principal parts of an incandescent lamp, also known as GLS (General Lighting Service) lamp include the filament, the bulb, the filling and the cap.

### **Reflector lamps**

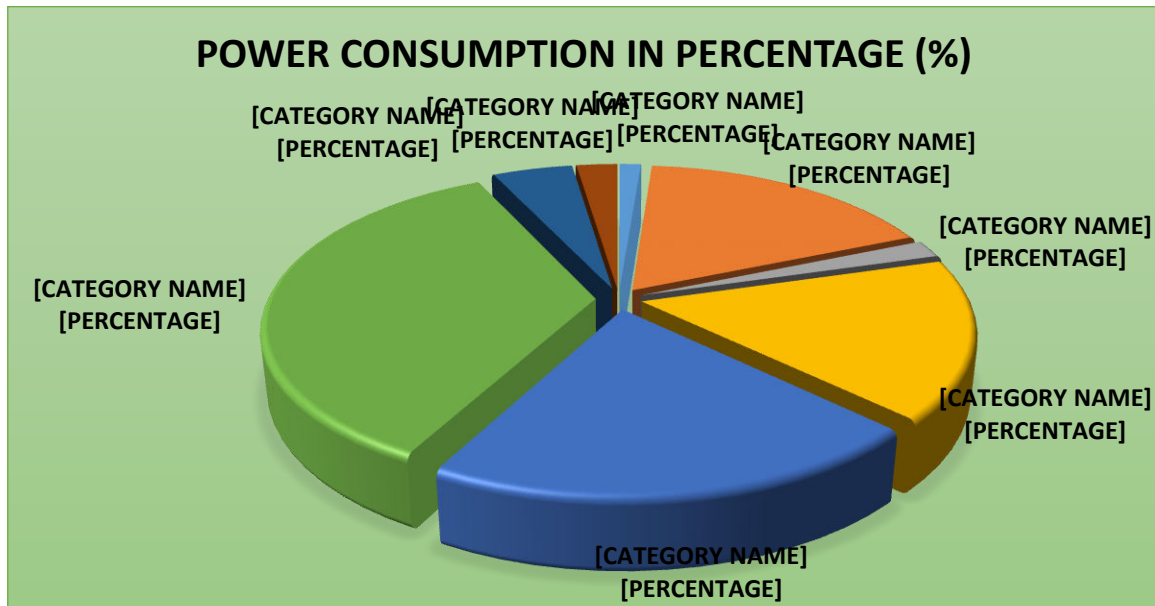
Reflector lamps are basically incandescent, provided with a high-quality internal mirror, which follows exactly the parabolic shape of the lamp. The reflector is resistant to corrosion, thus making the lamp maintenance free and output efficient.

### **Gas discharge lamps**

The light from a gas discharge lamp is produced by the excitation of gas contained in either a tubular or elliptical outer bulb. The most used discharge lamps are as follows:

- Fluorescent tube lamps (FTL)
- Compact Fluorescent Lamps (CFL)
- Mercury Vapor Lamps
- Sodium Vapor Lamps
- Metal Halide Lamps

### 15.6.1 Representation of Percentage Wattage Consumption



### 15.6.2 Observation

It is observed that the consumption of old conventional light (Tube light & HPSV light) is very high. It is recommended to replace old inefficient conventional light with energy-efficient LED Light.

### 15.6.3 Energy Saving Potential

Replacement of Tube Light of 40 W with 20 W LED Tube		
Particulars		Units
Total Number of 36Watt Tube Light	9873	Nos.
Measured Watt	40	Watts
Total kW Annual	710856	kW
Proposed watt after replacement	20	Watts
Total kW Saving After Replacement	355428	kW
Operating Hours in a day	5	Hours
Estimated Energy Saving after	355428	KW

Replacement Annual KW		
Per Unit Costas Per APDCL Bill	7.50	Rs
Estimated Cost Saving Per Year	2665710	Rs
Cost of Per Fixtures	300	Rs
Total Investment Cost	2961900	Rs
Pay back	1.11	Year

Replacement of CFL Light of 18 W with 9W LED bulb		
Particulars		Units
Total Number of 18 W CFL light	1557	Nos.
Measured Watt	18	Watts
Total kW (Annual)	50446.80	Watts
Proposed watt after replacement	9	Watts
Total kW Saving After Replacement	25223.40	Watts
Operating Hours in a day	5	Hours
Per Unit Cost as Per APDCL Bill	7.50	Rs
Estimated Cost Saving Per Year	189175.50	Rs
Cost of Per Fixtures	100	Rs
Total Investment Cost	155700.00	Rs
Pay back	.82	Year

Replacement of Street Light of 60 With 30 W LED Flood Light		
Particulars		Units
Total Number of 60-Watt Street Light	900	Nos.
Measured Watt	60	Watts
Total kW	97200	kW

Proposed watt after replacement	30	Watts
Total kW Saving After Replacement	48600	kW
Operating Hours in a day	5	Hours
Estimated Energy Saving after Replacement Annual KW	48600	KW
Per Unit Cost as Per APDCL Bill	7.50	Rs
Estimated Cost Saving Per Year	364500.00	Rs
Cost of Per Fixtures	1000	Rs
Total Investment Cost	900000	Rs
Pay back	2.46	Year

### 15.7 Ceiling Fans

Ceiling Fan is the major part which consumes electricity and however, it is very useful in household, universities, offices, etc. Hence, Innovation and continuous improvement in the field of fans, have given rise to tremendous energy-saving opportunities in this area. The fan is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy-efficient Fans, BLDC Fans, smart Fans, apart from good operational practices.

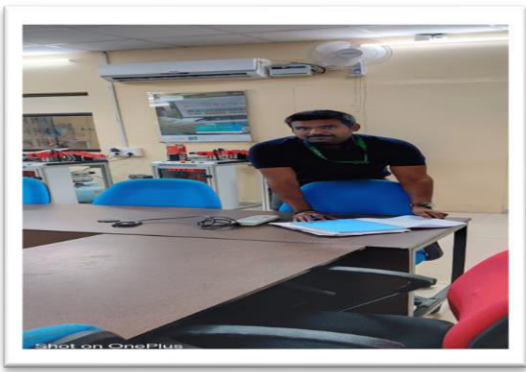
Replacement of Normal Ceiling Fan of 60W with 30 W BLDC Fan		
Particulars		Units
Total Number of 60 W Ceiling Fan	6288	Number
Measured Watt	60	Watts
Total KW	377280	kW
Proposed watt after replacement	30	Watts
Total kW After Replacement	188640	kW
Operating Hours in a day	5	Hours
Estimated Energy Saving after Replacement Annual KW	339552	kW
Per Unit Cost as Per APDCL Bill	7.50	Rs
Estimated Cost Saving Per Year	2546640	Rs
Cost of Per Fan	1500	Rs
Total Investment Cost	9432000	Rs

Payback	3.70	Year
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## Energy Conservation and Renewable energy

### 16 Renewable Energy

Chemical Engineering department of Andhra University was checked. Total load of this department is 120 kW out of which 60kW energy is being consumed through solar plant installed on the roof top. It also has capacity to transfer to the grid as per need and necessity. Further the department is in process of converting wind energy into next source of renewable energy which will also cater further need of the department. By 2024 Chemical Engineering has planned to become Carbon neutral as no energy will be taken from grid.



Star Rated Air Conditioned provided at Andhra University



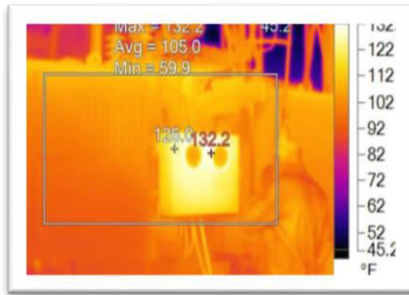


Renewable Energy on the roof top of Chemical Engineering Department



Transformers at different places and classrooms at Andhra University

## 16.1 Thermal Image of Transformer



Visible Light Image

## 16.2 FANS

- 16.2.1 Use smooth, well-rounded air inlet cones for fan air in takes.
- 16.2.2 Avoid poor flow distribution at the fan inlet.
- 16.2.3 Minimize fan inlet and outlet obstructions.
- 16.2.4 Clean screens, filters, and fan blades regularly
- 16.2.5 Use aero foil-shaped fan blades.
- 16.2.6 Minimize fan speed.
- 16.2.7 Use low-slip or flat belts.
- 16.2.8 Check belt tension regularly.
- 16.2.9 Eliminate variable pitch pull eyes.
- 16.2.10 Use variable speed drives for large variable fan loads.
- 16.2.11 Use energy-efficient motors for continuous or near-continuous operation.
- 16.2.12 Eliminate leaks in duct work.
- 16.2.13 Minimize bends in duct work
- 16.2.14 Turn fans off when not needed

## 16.3 PUMPS

- 16.3.1 Operate pumping near best efficiency point.
- 16.3.2 Modify pumping to minimize throttling.
- 16.3.3 Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
- 16.3.4 Stop running both pumps-add an auto-start for a non-line spare or add a booster pump in the problem area.

- 16.3.5 Use booster pumps for small loads requiring higher pressures.
- 16.3.6 Increase fluid temperature differentials to reduce pumping rates.
- 16.3.7 Repair seals and packing to minimize water waste.
- 16.3.8 Balance the system to minimize flows and reduce pump power requirements.
- 16.3.9 Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

## 16.4 LIGHTING

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- 16.4.1 Reduce excessive illumination levels to standard levels using switching; dimming, etc. (Know the electrical effects before doing delamping.)
- 16.4.2 Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- 16.4.3 Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc.
- 16.4.4 Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.
- 16.4.5 Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
- 16.4.6 Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
- 16.4.7 Consider lowering the fixtures to enable using less of them.
- 16.4.8 Consider day lighting, skylights, etc.
- 16.4.9 Consider painting the walls on a lighter color and using less lighting fixtures or lower wattages.
- 16.4.10 Use task lighting and reduce background illumination.
- 16.4.11 Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
- 16.4.12 Change exit signs from incandescent to LED.

## 16.5 DGSETS

- o Optimize loading
- o Use waste heat to generate steam/hot water/power and absorption chiller or preheat processor utility feeds.

- o Use jacket and head cooling water for process needs
- o Clean air filters regularly
- o Insulate exhaust pipes to reduce DG set room temperatures.

### **16.5.1 WATER & WASTE WATER**

**16.5.2** Recycle water, particularly for uses with less-critical quality requirements.

**16.5.3** Recycle water, especially if sewer costs are based on water consumption.

**16.5.4** Balance closed systems to minimize flows and reduce pump power requirements.

**16.5.5** Eliminate once-through cooling with water.

**16.5.6** Use the least expensive type of water that will satisfy their requirement.

**16.5.7** Fix water leaks.

**16.5.8** Test for underground water leaks. (It's easy to do over a holiday shut down.)

**16.5.9** Check water overflow pipes for proper operating level.

**16.5.10** Automate blow down to minimize it.

**16.5.11** Provide proper tools for wash down—especially self-closing nozzles.

**16.5.12** Reduce flow at water sampling stations.

**16.5.13** Eliminate continuous overflow at water tanks.

**16.5.14** Promptly repair leaking toilet and faucets.

**16.5.15** Use water restrictors on faucets, showers, etc.

**16.5.16** Use self-closing type faucets in rest rooms.

### **16.6 ENERGY MANAGEMENT STRATEGY**

Energy Management should be seen as a continuous process. Strategies should be reviewed annually and revised as necessary. The key activities suggested have been outlined below:

#### **16.6.1 UNIVERSITY CORPORATE APPROACH**

The starting point in energy management is to identify a strategic corporate approach to energy management. Clear accountability for energy usage needs to be established, appropriate financial and staffing resources must be allocated, and reporting procedures initiated. An energy management program requires commitment from the whole organization in order to be successful. A record of Energy consumption must be kept and monitored on regular basis, to optimize the Energy consumption. For this, various meters may have to be installed.

##### **16.6.1.1 DESIGNATE AN ENERGY MANAGER**

An Energy Manager must be identified, and time bound responsibility must be given to him in getting implemented the findings of the Energy Audit points, which the Plant

Establishment has planned to implement.

#### ***16.6.1.2 SETUP AN ENERGY MONITORING AND REPORTING SYSTEM***

Successful energy management requires the establishment of a system to collect/analyze and report the energy costs and consumption pattern. This will enable an overview of energy use and its related costs, as well as facilitating the identification of savings that might otherwise not be detected. The system needs to record both historical and ongoing energy use, as well as cost information from billing data, and capable of producing summary reports on a regular basis. This information will provide the means by which trends can be analyzed and reviewed for corrective measures.

#### ***16.6.1.3 IMPLEMENT A STAFF AWARENESS AND TRAINING PROGRAM***

A key ingredient to the success of an energy management program is maintaining a high level of awareness among staff. This can be achieved in a number of ways, including formal training, newsletters, posters and publications. It is important to communicate program plans and case studies that demonstrate savings, and to report results at least at 12-month intervals. Staff may need training from specialists on energy saving practices and equipment.

### ***16.7 Biodegradable Waste Management–Vermicomposting Unit***

University has taken initiative for Biodegradable Waste Management to compost using processes like Dry & Wet Waste Management. Vermicomposting technology relies upon the conjoint action of earth worms and microorganisms to rapidly transform varied types of solid wastes. Consider the simplicity and flexibility of the technology. It is essential to create vermicomposting as lots of dead leaves, food waste etc. are available in university campus. The vermicompost is being utilized at all places in India. It can also be sold at a good price if not utilized in the campus. in the University under the supervision of the Horticulture Section. The prime objectives are to recycle biodegradable waste fractions in a sustainable manner and curtail the cost of purchasing organic manure from the market for landscaping ventures. Presently, the unit is running successfully to fulfill the need for organic manure for plantation/gardening works of the University. So far, the ready-to-use vermicompost is produced entirely from garden waste (grass) and leaf litter of the campus.



On average, one vermicomposting period (or one batch) takes about 60-90 days depending on the nature of the feedstock. Epegeic earthworm species (*Eiseniafetida*, *Eudriluseugeniae*, and *Perionyxexcavatus*) are applied data rate of 10 worms/kg (approximately) feed stock to carry out the composting process. The produced vermicompost is used for all sorts of plantation and landscaping activities at the University. The unit shall be ready for expansion to accommodate various other kinds of bio-degradable solid wastes generated in the University. Apart from utilizing the required amount of vermicompost for landscaping work, University is selling certain quantities to the campus Wellers. The table below shows the revenue generated from selling Vermicompost from the Departmental Vermicompost Unit of Horticulture Section.

### ***16.8 Initiatives taken by the University for Waste Management***

- Glass waste is generated from the laboratory mainly in the form of bottles; Many times, bottles are reused for storing other chemicals.
- Thee-waste generated at Andhra University is sent for recycling and reuse.
- Hazardous waste generated in a solid and liquid state during experiments in the laboratory is disposed of properly.
- Biodegradable waste is a major solid waste generated on campus which may further be treated by vermicompost technology.
- University has banned single use of plastic for any administrative as well as other purposes.

## 16.9 Recommendations

- Provision of installation of garbage units hold be introduced where them utile vel segregation of various wastes such as paper, construction, glass, metal scrap, and food waste should be done. Further various waste recycling plans for different types of waste should be introduced.
- Provision for E-waste management should be introduced in the University Campus.
- Paper waste like answer sheets, old bills, and confidential reports should be sent for shredding, pulping, and recycling after completion of their preservation period.
- It was informed that University has adopted E Office policy but unfortunately the paper reduction is not much. It shall be ensured that E Office should function effectively so that use of paper is educed considerably reduced.
- Recycling facilities should be introduced and should be supported by City Municipality and private suppliers, including glass, cans, white, colored, and brown paper, plastic bottles, batteries, print cartridges, cardboard, and furniture.

## 17 Biodiversity

The Biodiversity Audit Approach is an innovative, landscape-scale and evidence-based approach to delivery of biodiversity. It provides a working example of the implementation of an integrated approach to biodiversity delivery in a region. A key element has been the development of an evidence-based approach to understanding the requirements of priority species and providing guidelines for their conservation. Ecological requirements of priority species for conservation have been collated, and synthesized, integrating across numerous individual priority species to produce management guidance for multi-species assemblages. The approach: Collates and examines available evidence to understand what species are present. Objectively defines the suite of conservation priority species. Assess the recent or current status of priority species. A key objective of the approach is to provide land managers and conservation advisers with guidance on how to enhance and sustain the important biodiversity. Effective management is best achieved by providing prescriptions based on sound evidence. The novel approach taken is to identify multi-species assemblages and associated flagship invertebrate and plant species, requiring similar ecological processes and conditions ('guilds'). This has the aim of integrating prescriptions

for multiple species into habitat-based approaches, but through an evidence-based approach rooted in an understanding of the requirements of individual species.

This includes the plants, greenery, and sustainability of the campus to ensure that the buildings conform to green standards. This also helps in ensuring that the Environmental Policy is enacted, enforced, and reviewed using various environmental awareness programs.

### *Biodiversity*

To keep the greeneries in the campus, the University regularly maintains the gardens which are looked after by concerned staff under the guidance of higher authorities of the University. Activities organized to create greenery and its conservation at the university campus is as follows-

- Plantation of diversified species, Uses of medicinal plants, Identification of plants species.
- Waste management plan and disposal facility.
- Awareness of carbon consumption and carbon footprint program.

To create a green cover, Eco-friendly atmosphere, pure oxygen at the university campus, a plantation program is organized every year with active participation from the university community and visitors. A committee has been formed as the Campus Horticulture Committee to keep the greeneries in the University campus. All gardens are regularly maintained and looked after by Horticulture Section under the guidance of committee members. Various departmental activities are being carried out every year such as: -

- Plantations and other Landscaping Activities
- Maintenance of Gardens and Landscape
- Maintenance of Plantations

The horticultural activities for landscaping and beautification of Andhra University are headed by full fledge Director having his own team. There were transformation and redeemed of certain natural vegetation patches for requisite infrastructure development to facilitate the emerging needs for the growth of the university. However, spaces for academic, administrative and recreational areas are delaine at harmony with the landscape to ensure an eco-friendly campus. Horticulture section headed by Director, Horticulture and gardening unit is posted in the University is



looking after althea plantation and other landscaping activities within the University campus under the guidance of a by Director, Horticulture, and gardening unit. by Director, Horticulture and gardening unit has under him a team of dedicated staffs who are only dedicated to horticulture and Gardening work & develops strategies for smooth execution of plantation, maintenance and overall protection of the landscape. Therefore, greenery of the large area in the campus is well maintained besides keeping remnants of the natural vegetation patches undisturbed. There are block plantation, plantations along roads side, garden space of departmental building premises, and along the residential compounds, while several tree species regenerated naturally and there are plants that cover the whole natural and scrapes. Several trees, plants are carefully selected for the plantation to provide shelter for birds and to deliver a shaded walkway. Massive plantations and different landscaping beautification activities have already been carried out in different parts of the University campus.

## **18 PLANTATIONS**

Towards the sustainable land use practice, a total of 10,000 plant saplings of different species have been planted in various sites in the last 1 decade (from July'2012 to March 2021) through routine and special plantation drives organized by the Horticulture Section, Andhra University on various national and international events/occasions with active participation from university communities and guests. This program helps in encouraging an eco-friendly environment that provides pure oxygen within the institute and awareness among villagers. The plantation program includes various types of indigenous species of ornamental and medicinal wild plant species. The plants have medicinal value, which faculty members of the Department of Environmental Science help students to identify with scientific names and give information about medicinal uses of the plants.



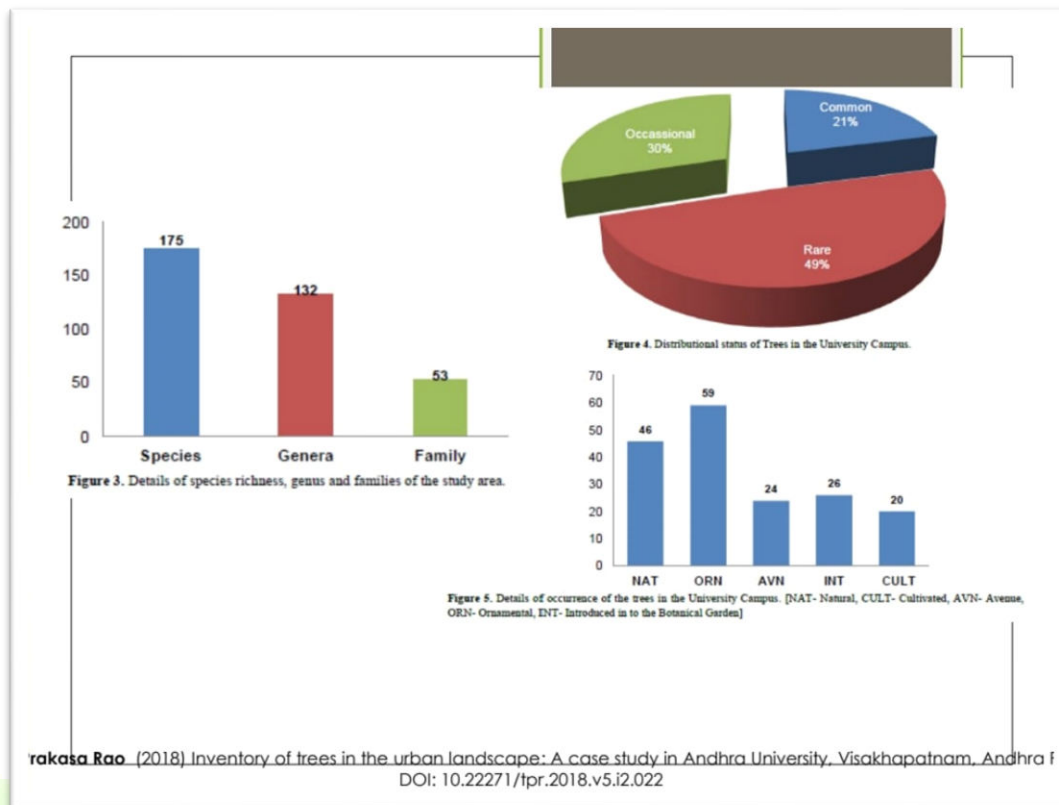
## Medicinal Garden



### **18.1 LANDSCAPING AND GARDENING ACTIVITIES**

In addition, to carry out different plantation programs, efforts were also made by the Horticulture Section, Andhra University for beautification of different parts of the University campus by the development of flower gardens and other landscaping activities such as the development of lawns, hedges, ornamental and avenue plantations, etc. From July'2012 to March'2021, landscaping and gardening work in most of the prime locations of the University campus like the front side of the Entrance gate, different Administrative and Academic buildings, Guest House, Central Library, Auditorium, Vice-Chancellor's office area, etc. and other amenity centers have been completed. Several greenery areas have also been developed within the University campus. Moreover, plantation of different types of orchid on the existing trees of different locations of the University campus has also been done for further beautification of the landscape.

## 18.2 MAINTENANCE OF GARDENS AND LANDSCAPE



In addition to new plantation drives and landscaping/beautification activities, all essential maintenance work (like lawn, hedge, existing plants /shrubs, growing of seasonal flowers) for previously developed flower and other gardens, as well as other locations of the University campus, is done regularly under the supervision of Horticulture Section.

## Visitors



### **18.3 MAINTENANCE OF PLANTATIONS**

Apart from the maintenance of gardens, all previously planted trees (like roadside and other plantations) in different locations of the University campus are regularly nurtured by cleaning, fertilization, watering, etc.

### **18.4 HOUSE PLANTS**

House plants do not just look good – they can make us feel good, too. Studies have shown that house plants-

- Boost our mood, productivity, concentration, and creativity
- Reduce our stress, fatigue, sore throats, and colds
- Help clean indoor air by absorbing toxins, increasing humidity & producing oxygen.
- Add life to sterile space, give privacy and reduce noise levels.

Considering the different benefits of house plants, currently, about 950 House plant pots a

replaced in the interior space of different administrative offices and Academic buildings, Guest House, Library, Auditoriums, VC's residence etc. and other amenity centers for beautification, greenery, and purifying the air. Essential maintenance works of these house plants are carried out regularly under the supervision of the Horticulture Section, Andhra University,

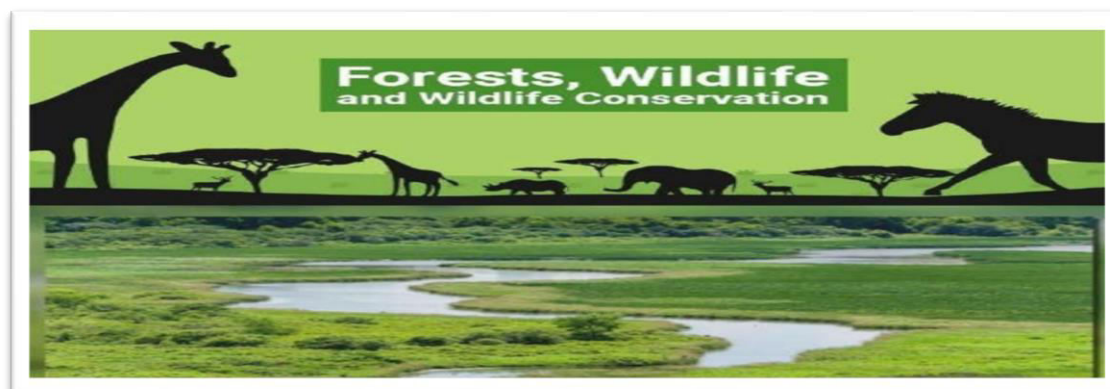
### ***18.5 Campus Involvement***

For sustainable use of resources and for the mission of "GO-GREEN" it is necessary that the students, faculty, and administration welcome it. Andhra University is an environment that invites opportunities to better its community through campus organizations. The green initiative started on the campus many years ago. The University students are actively participating and solely concerned with the environment. These students under the guidance of faculties strive to create an environmentally friendly campus. Their purpose is to create awareness and eventually act on that awareness. University is also actively conducting environmental awareness programs on campus regularly.

### ***18.6 Environmental Conservation Program***

University is very active in the practical education of the students with regard to environmental conservation. The University has arranged visits to their faculties to the Wildlife Institute of India (WII), Botanical Garden, Sanctuaries, Zoological Park sacred grooves in order to educate their students. The University also took their students to different National Park in order to educate the students about in situ Conservation of Wildlife.

## ***19 Protection of biodiversity of Flora Fauna associated with University: -***



## **19.1 BIODIVERSITY OF FLORA FAUNA ASSOCIATED WITH IN UNIVERSITY CAMPUS**

### **Introduction**

Biodiversity is one measure of the health of biological systems. Life on earth today consists of many millions of distinct biological species. Biodiversity is not consistent across the earth. It is consistently rich in the tropics, and it is less rich in Polar Regions where conditions support much less biomass. A complex relationship exists among the different diversity levels. Identifying one level of diversity in a group of organisms does not necessarily indicate its relationship with other types of diversities. Rapid environmental changes typically cause extinctions. Most species that have existed on earth are now extinct. The period since the emergence of humans has displayed an ongoing reduction in biodiversity. Named the Holocene extinction, the reduction is caused primarily by human impacts, particularly the destruction of plant and animal habitats.

### **19.2 Western Ghats**

Western Ghats, older than the Himalayas, is one of the 34 Global Hotspots of Biodiversity – flora, fauna, landscape and ethnicity. Climatic conditions in the Western Ghats vary with the altitude and physical proximity to the Arabian Sea and the equator. Although the Western Ghats experience a tropical climate – being warm and humid during most of the year with mean the temperature ranging from 20°C in the south to 24°C in the north, the higher elevations experience subtropical climates and on occasions frost. Further, it has been observed that the coldest periods in the southern Western Ghats coincide with the wettest. Whereas rainfall peaks of 9000 mm and above per year, are known locally, annual rainfall as low as 1000 mm are frequent in the east bringing the average to around 2500 mm. Much of the rainfall is received during the southwest monsoon season. Peak period of rainfall is July to August.

### **19.3 Need for biodiversity conservation**

Conservation is the protection, preservation, management, or restoration of wildlife and natural resources such as forests and water. Through the conservation of biodiversity the survival of many species and habitats which are threatened due to human activities can be ensured. Other reasons for conserving biodiversity include securing valuable Natural Resources for future generations and protecting the wellbeing of eco-system functions. Plant genetic resources are the product of natural evolution and human intervention. In-situ biodiversity conservation includes the conservation of habitats, species and ecosystems where they naturally occur. The conservation of element of biodiversity out of the context of their natural habitats is referred as ex-situ biodiversity conservation. Concentration of genetic diversity comprising native species and landraces occurs more in Western Ghats, Northern Himalayas, Southern plateau, Central India and Northwestern Himalayas.

### **19.4 Fauna Survey**

#### **19.5 Pilot fauna survey**

Animal species present around each of the building locations were assessed. Places such as in and around the college vicinity, in the soil and on the vegetation around the college were checked and noted. Some of the fauna species which could not be identified on the field were collected for identification in Zoology laboratory of our college.

### 19.6 Questionnaire based fauna survey:

An assessment of animal species commonly cited around the study college area by pupils and workers of the college was also conducted through a structured interview schedule (questionnaire). The respondents were allowed to express the names of the animal species in their local language (Telugu or English).

### 19.7 Flora Survey

Direct observation of plants growing freely around the college were done to ensure a proper and more accurate plant survey. The collected plant samples were identified in the herbarium of the Department of Botany.

## 19.8 RESULT

### 20 Fauna Survey Pilot fauna survey:

A total of Thirty-five animal species were cited of the college area sampled. Fauna species observed in the study area were good representative of the animal kingdom as they cut across the insect group, other invertebrates, reptiles, amphibians, birds and the mammals.

Fauna species were noted to be common to each of the study area. Among the fauna species common to the college study area, termites, ants, earthworms, lizards, spiders and springtails were observed to be more in abundance.

### 20.1 Questionnaire survey of fauna:

A total of thirty-five animal species was identified by the respondents to be present in the college study area. About nine types of the bird's species were observed. In that crow, cuckoo, sparrow, pigeon is commonly found in all of the buildings. Approximately 13 type of insects the frequency of occurrence of lizard, termites, cockroach, soldier ants, golden beetle were high among them are Home Dispensary, Post Office, Platinum Jubilee Guest House, Andhra University College of Arts and Commerce where more than those of the other animal species responded present in the study area of the college buildings. About 6 types of invertebrates are found in the vicinity of the campus area. Also, reptiles, amphibian's ad mammalians were also cited.

### 20.2 Flora survey

We have identified different trees from different genera and families and ornamental plants and have studied their properties and uses. There are many trees and ornamental plants which are rare in the college campus, such plants are planted in different parts of campus and monitored for proper growth. Plants which are having frequency less than 0.1% were chosen for conservation these are some plants are chosen for vegetative propagation that includes, *Pisonia alba*, *Leucaena leucocephala*, *Thespesia populnea*, *Aloevera*.

The highest diversity of plant was observed in the college campus with 38 plant species. The number of *Azadirachata indica* was found to be the highest planted trees. *Phyllanthus niruri* was the second topmost plant found in the campus area. *Millingtonia hortensis* was the third topmost plant found in the campus area. *Holoptelea integrifolia* and *Pongamia pinnata* commonly found plants. Only five plant species (*Synedrella nodiflora*, *Sida acuta*, *Euphorbia hirta*, *Commelina benghalensis* and *Amaranthus spinosus*) were common to all the study sawmills while *Abutilon mauritianum*, *Axonopus compressus*, *Euphorbia hysoppifolia*, *Gomphrena celosoides* and *Sida rhombifolia* occurred in four of the five sawmill locations.



### 20.3 Discussion

The major component of an ecosystem is the plants. They are major modifiers of climate and providers of community structures, and they are pathway through which energy enters the ecosystem. The plant forms a complex interaction between the biotic and abiotic entities of the environment by making use of the biotic entities as food to produce food in form of biomass for the animal communities. High diversity of animal species within the college vicinities as recorded in this study could therefore be connected to the observed high diversity of plant species.

This study has shown that the college environments have rich and abundant flora and fauna populations which could be regarded as a biotic community consisting of the populations of different organisms interacting together. It also revealed that the activities on the study area may not be completely detrimental to the existence of the organisms. Thus, if well maintained, college activities are not entirely unfriendly to the biotic community.

Although, it is not a common practice to base ecological research on questionnaire survey, this study has revealed that the opinion of people who have been used to a particular area over a long period of time on the fauna species usually encountered in such areas should not be discarded. However, there is the need for a field survey to backup verbal responses.

**21.1 National Ambient Air Quality Program (NAAQM)**

Central Pollution Control Board, New Delhi initiated National Ambient Air Quality Monitoring (NAAQM) program in the year 1984 to get a spatial and temporal variation of ambient air concentrations for a wide range of pollutants that are considered relevant for evolving strategic management plan. The program was subsequently renamed NAMP (National Air Quality Monitoring Program). Under NAMP, three air pollutants viz., Sulphur dioxide (SO<sub>2</sub>), Nitrogen dioxides (NO<sub>2</sub>), and Repairable Suspended Particulate Matter (RSPM/PM<sub>10</sub>) have been identified for regular monitoring at three locations. Monitoring of pollutants has been carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) as per CPCB monitoring protocol. One Repairable Dust Sampler (RDS) machine is installed at the Main Gate of the University Campus which monitored the changes in ambient air quality during 24- hours. Andhra University monitors air pollution regularly under National Ambient Air Quality Monitoring Program, Central Pollution Control Board, New Delhi.

**21.2 Ambient air quality in the Andhra University campus area**

AQI and other parameter of air quality for 5 different places in AU were taken. All the air pollutants were found well within the excellent parameters.

AQI and other parameter of air quality for 5 different places in AU was taken. All the air pollutants were found well within the excellent parameters.

The nearest place which monitors AQI, and other parameters are 2.3 Km away from Andhra University. This place is GVM Corporation – Area

The AQI recorded at that place is as under:

Parameters	GVM Corporation – Area	Dwarka Nagar	Pedda Waltair

	(Source CPCB)		
AQI	44	32	59
PM 2.5	23 $\mu\text{g}/\text{m}^3$	8 $\mu\text{g}/\text{m}^3$	16 $\mu\text{g}/\text{m}^3$
PM 10	43 $\mu\text{g}/\text{m}^3$	32 $\mu\text{g}/\text{m}^3$	42.99 $\mu\text{g}/\text{m}^3$
CO	0 ppm		0.91 ppm
Ozone	7 ppb	8 ppb	5.68 ppb
NO <sub>2</sub>	18 ppb	10 ppb	25.21 ppb
SO <sub>2</sub>	13 PPB	8 ppb	8.88 nppb
NH <sub>3</sub>	5 ppb		
Humidity		79%	76%
Temp		28 <sup>0</sup> C	
Pressure		1009.0 mb	
Wind speed		10.1 Km/ h, ENE	
UV		1.0	

Central Pollution Control Board, New Delhi has set guidelines to monitor and analyze the air pollution quality parameters. The trees cover on the campus is the leading sources to absorb CO<sub>2</sub> and release enough fresh O<sub>2</sub> across the University Campus. The result shows that Andhra University Campus's air quality status is good as compared to other locations. It is identified that Andhra University's campus is a green campus. University campus observed minimum air pollution as compared to other Ambient Air Pollution Centers located in different parts of the city. More than 50% area of the University is full of lush greenery which has definitely contributes much for its achievement over such an excellent AQI.

### 21.2.1 Carbon Monoxide (CO)

**21.2.1.1** Carbon monoxide poisoning occurs when carbon monoxide builds up in your bloodstream. When too much carbon monoxide is in the air, your body replaces the oxygen in your red blood cells with carbon monoxide. This can lead to serious tissue damage, or even death.

**21.2.1.2** Carbon monoxide is a colorless, odorless, tasteless gas produced by burning gasoline, wood, propane, charcoal or other fuel. Improperly ventilated appliances and engines, particularly in a tightly sealed or enclosed space, may allow carbon monoxide to accumulate to dangerous levels.

Signs and symptoms of carbon monoxide poisoning may include:

- Dull headache
- Weakness
- Dizziness
- Nausea or vomiting
- Shortness of breath
- Confusion
- Blurred vision
- Loss of consciousness

### 21.2.2 Causes

Carbon monoxide poisoning is caused by inhaling combustion fumes. When too much carbon monoxide is in the air you're breathing, your body replaces the oxygen in your red blood cells with carbon monoxide. This prevents oxygen from reaching your tissues and organs.

Various fuel-burning appliances and engines produce carbon monoxide. The amount of carbon monoxide produced by these sources usually isn't cause for concern. But if they're used in a closed or partially closed space — cooking with a charcoal grill indoors, for example — the carbon monoxide can build to dangerous levels.

Smoke inhalation during a fire also can cause carbon monoxide poisoning.

### 21.2.3 Risk factors

Exposure to carbon monoxide may be particularly dangerous for:

- **Unborn babies.** Fetal blood cells take up carbon monoxide more readily than adult blood cells do. This makes unborn babies more susceptible to harm from carbon monoxide poisoning.
- **Children.** Young children take breaths more frequently than adults do, which may make them more susceptible to carbon monoxide poisoning.
- **Older adults.** Older people who experience carbon monoxide poisoning may be more likely to develop brain damage.
- **People who have chronic heart disease.** People with a history of anemia and breathing problems also are more likely to get sick from exposure to carbon monoxide.

- Those in whom carbon monoxide poisoning leads to unconsciousness. Loss of consciousness indicates more severe exposure.

#### 21.2.4 Complications

Depending on the degree and length of exposure, carbon monoxide poisoning can cause:

- Permanent brain damage
- Damage to your heart, possibly leading to life-threatening cardiac complications
- Fetal death or miscarriage
- Death

#### 21.2.5 Prevention

Simple precautions can help prevent carbon monoxide poisoning:

- **Install carbon monoxide detectors.** Put one in the hallway near each sleeping area in your house. Check the batteries every time you check your smoke detector batteries — at least twice a year. If the alarm sounds, leave the house and call 911 or the fire department. Carbon monoxide detectors are also available for motor homes and boats.
- **Open the garage door before starting your car.** Never leave your car running in your garage. Be particularly cautious if you have an attached garage. Leaving your car running in a space attached to the rest of your house is never safe, even with the garage door open.
- **Use gas appliances as recommended.** Never use a gas stove or oven to heat your home. Use portable gas camp stoves outdoors only. Use fuel-burning space heaters only when someone is awake to monitor them and doors or windows are open to provide fresh air. Don't run a generator in an enclosed space, such as the basement or garage.
- **Keep your fuel-burning appliances and engines properly vented.**

These include:

- Space heaters
- Furnaces
- Charcoal grills
- Cooking ranges
- Water heaters

- Fireplaces
- Portable generators
- Wood-burning stoves
- Car and truck engines

Ask your utility company about yearly checkups for all gas appliances, including your furnace.

- **If you have a fireplace, keep it in good repair.** Clean your fireplace chimney and flue every year.
- **Keep vents and chimneys unblocked during remodeling.** Check that they aren't covered by tarps or debris.
- **Make repairs before returning to the site of an incident.** If carbon monoxide poisoning has occurred in your home, it's critical to find and repair the source of the carbon monoxide before you stay there again. Your local fire department or utility company may be able to help.
- **Use caution when working with solvents in a closed area.** Methylene chloride, a solvent commonly found in paint and varnish removers, can break down (metabolize) into carbon monoxide when inhaled. Exposure to methylene chloride can cause carbon monoxide poisoning.

When working with solvents at home, use them only outdoors or in well-ventilated areas. Carefully read the instructions and follow the safety precautions on the label.

### **21.2.6 Carbon Dioxide (CO<sub>2</sub>)**

Carbon dioxide (CO<sub>2</sub>) is an important heat-trapping gas, or greenhouse gas, that comes from the extraction and burning of fossil fuels (such as coal, oil, and natural gas), from wildfires, and from natural processes like volcanic eruptions. The first graph shows atmospheric CO<sub>2</sub> levels measured at Mauna Loa Observatory, Hawaii, in recent years, with natural, seasonal changes removed. The second graph shows CO<sub>2</sub> levels during Earth's last three glacial cycles, as captured by air bubbles trapped in ice sheets and glaciers.

Since the beginning of industrial times (in the 18th century), human activities have raised atmospheric CO<sub>2</sub> by 50% – meaning the amount of CO<sub>2</sub> is now 150% of its value in 1750. This is greater than what naturally happened at the end of the last ice age 20,000 years ago.

The animated map shows how global carbon dioxide has changed over time. Note how the map changes colors as the amount of CO<sub>2</sub> rises from 365 parts per million (ppm) in 2002 to over 400 ppm currently. ("Parts per million" refers to the number of carbon dioxide molecules per million molecules of dry air.) These measurements are from the mid-troposphere, the layer of Earth's atmosphere that is 8 to 12 kilometers (about 5 to 7 miles) above the ground.

As per Andhra Pradesh Pollution Control Board Data Published

Annual average values of ambient air quality monitoring stations operated under SAAQM for the period from 2014 to 2018						
S.No	Year	Location	SPM	SO2	NO2	NH3
1	2014	Madhavadhara, Visakhapatnam, Residential	52	11.2	18.1	-
	2015		49	7.2	15.8	-
	2016		64	6.7	12.9	-
	2017		60	7.0	13.0	-
	2018		56	8.8	18.5	-
2	2014	Viziangaram, Residential/commercial	83	-	-	-
	2015		93	-	-	-
	2016		68	7.8	17.9	-
	2017		71	7.7	17	68
	2018		69	8.8	19.2	61
3	2014	Venkatarama puram, Nellore, Residential	60	-	-	-
	2015		65	-	-	-
	2016		66	-	-	-
	2017		65	-	-	-
4	2014	Industrial Estate, Kallur	93	-	-	-
	2015		98	-	-	-

2016	97	-	-	-
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Monthly average values of ambient air quality monitoring station separated under SAAQM during the year 2019						
S.No	Months	Location	SPM	SO2	NO2	NH3
1	January	Madhavadhara, Visakhapatnam, Residential	59	9.0	20.0	-
	February		66	10.0	23.0	-
	March		73	9.0	22.0	-
	April		60	8.0	17.0	-
	May		51	8.0	19.0	-
	June		47	8.0	18.0	-
2	January	Viziangaram, Residential/comme rcial	62	7.0	15.0	59
	February		60	9.0	21.0	73
	March		63	8.0	20.0	70
	April		67	8.0	19.0	67
	May		66	7.0	18.0	63
	June		70	8.0	19.0	56

Note: All values are expressed in ug/m3.  
As per CPCB Guidelines

### 21.2.7 Formaldehyde (HCHO) As a Hazardous Air Pollutant

Formaldehyde (HCHO) is the most important carcinogen in outdoor air among the 187 hazardous air pollutants (HAPs) identified by the U.S. Environmental Protection Agency (EPA), not including ozone and particulate matter. However, surface observations of HCHO are sparse and the EPA monitoring network could be prone to positive interferences. Here we use 2005–2016 summertime HCHO column data from the OMI satellite instrument, validated with high-quality aircraft data and oversampled on a 5 × 5 km<sup>2</sup> grid, to map surface air HCHO concentrations across the contiguous U.S. OMI-derived summertime HCHO values are converted to annual averages using the GEOS-Chem chemical transport model. Results are in good agreement with high-quality summertime observations from urban sites (–2% bias, r = 0.95) but a factor of 1.9 lower than annual means from the EPA network. We thus estimate that up to 6600–12 500 people in the U.S. will develop cancer over their lifetimes by exposure to outdoor HCHO. The main HCHO source in the U.S. is atmospheric oxidation of



biogenic isoprene, but the corresponding HCHO yield decreases as the concentration of nitrogen oxides ( $\text{NO}_x \equiv \text{NO} + \text{NO}_2$ ) decreases. A GEOS-Chem sensitivity simulation indicates that HCHO levels would decrease by 20–30% in the absence of U.S. anthropogenic  $\text{NO}_x$  emissions. Thus,  $\text{NO}_x$  emission controls to improve ozone air quality have a significant benefit in reducing HCHO-related cancer risks.

### 21.2.8 Total Volatile Organic Compounds (TVOC)

Definition of TVOC There is different classifications of Total Volatile Organic Compounds (TVOC). Most commonly used is the World Health Organization (WHO) definition<sup>1</sup>, which differentiates the volatility (or boiling point) of organic compounds to define Very Volatile Organic Compounds (VVOCs), Volatile Organic Compounds (VOC) and Semi-volatile Organic Compounds (SVOCs) as defined in Table 1. This usually involves the molecular length of the carbon structure, i.e., the number of carbon atoms in the chemical formula. The summation of all VOCs is called the Total Volatile Organic Compounds (TVOC). The volume of gas per classification and the sum of all gases (TVOC) are important reflections of the relevant organic compounds found in indoor air. Table 1. Classifications of Volatile Organic Compounds

Class	Name	Typical Boiling Point [°C]	Typical Number of Carbon Molecules	Example
VVOC	Very Volatile Organic Compound	< 50	0 to 5	Formaldehyde
VOC	Volatile Organic Compound	50 — 100	6 to 10	Benzene
SVOC	Semi Volatile Organic Compound	100 to 240	11 to 16	Phthalate
TVOC	Total Volatile Organic Compounds	> 240	> 16	Sum of all VOCs

Figure 1 shows some of the reasons for concern about the TVOC inside buildings. The TVOC is considered an important indicator for indoor hygiene and indoor air quality (IAQ). In addition to serious health concerns, there is the psychological aspect: homes, offices, and other environments that smell clean typically seem more welcoming than areas with foul odors caused by organic compounds.

Common Volatile Organic Compounds in Indoor Spaces and their Sources Volatile organic compounds are pervasive both outdoors and indoors. Depending on the interior decoration and usage, a room might be polluted with different organic compounds at the same time. Figure 2 shows typical sources of volatile organic compounds inside a home, and Table 2 gives potential examples and sources for the TVOC. Many volatile organic compounds have a chemical similar structure, which makes it difficult or sometimes impossible to distinguish between these in a VOC gas mixture. More information on detection of the TVOC can be found in Renesas' Application Note – TVOC Sensing. Figure 2 Typical Sources of the TVOC inside a Home Table 2. VOCs that Contribute to Poor Air Quality and their Sources

Chemical Class	Chemical Examples	Source Examples
Alkanes	n Butane, n Pentane, n Hexane, n n-Octane, Cyclohexane	Heptane, Aerosol spray products for some paints, cosmetics, automotive exhaust products, leather treatments, paint thinner, oil based paints, spot removers, aerosol/liquid insect pest products, mineral spirits, furniture polishes
Alkenes	Isobutylene, Ethylene	Solvents, fruit ripening, pest control, rubber production
Aromatics	BTEX (Benzene, Toluene, Ethylbenzene, Xylene), Dichlorobenzene, Naphthalene, Styrene	Tobacco smoke, moth balls, moth flakes, deodorizers, air fresheners, automotive exhaust products, paint thinner, oil based paints, aerosol/liquid insect pest products, mineral spirits, furniture polishes, rigid foam products, contact cement, model cement, tar board, plasticizer.

### 21.2.9 Particulate Matter (PM)

PM stands for particulate matter (also called particle pollution): the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope.

Particle pollution includes:

- **PM<sub>10</sub>**: inhalable particles, with diameters that are generally 10 micrometers and smaller; and
- **PM<sub>2.5</sub>**: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.
  - How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle.

### *Sources of PM*

These particles come in many sizes and shapes and can be made up of hundreds of different chemicals.

Some are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires.

Most particles form in the atmosphere as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides, which are pollutants emitted from power plants, industries and automobiles.

#### *21.2.10 Particulate Matter 10 (PM 10)*

Using a nation wide network of monitoring sites, EPA has developed ambient air quality trends for particle pollution, also called Particulate Matter (PM). PM<sub>10</sub> describes inhalable particles, with diameters that are generally 10 micrometers and smaller. Under the Clean Air Act, EPA sets and reviews national air quality standards for PM. Air quality monitors measure concentrations of PM throughout the country. EPA, state, tribal and local agencies use that data to ensure that PM in the air is at levels that protect public health and the environment. Nationally, average PM<sub>10</sub> concentrations have decreased over the years.

#### *Particulate Matter 2.5 (PM 2.5)*

Fine particulate matter (PM<sub>2.5</sub>) is an air pollutant that is a concern for people's health when levels in air are high. PM<sub>2.5</sub> are tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated. Outdoor PM<sub>2.5</sub> levels are most likely to be elevated on days with little or no wind or air mixing. The New York State Departments of Health (DOH) and Environmental Conservation (DEC) alert the public by issuing a PM<sub>2.5</sub> Health Advisory when PM<sub>2.5</sub> concentrations in outdoor air are expected to be unhealthy for sensitive groups.

The term fine particles, or particulate matter 2.5 (PM<sub>2.5</sub>), refers to tiny particles or droplets in the air that are two- and one-half microns or less in width. Like inches, meters and miles, a micron is a unit of measurement for distance. There are about 25,000 microns in an inch. The widths of the larger particles in the PM<sub>2.5</sub> size range would be about thirty times smaller than that of a human hair. The smaller particles are so small that several thousands of them could fit on the period at the end of this sentence.

Particles in the PM<sub>2.5</sub> size range are able to travel deeply into the respiratory tract, reaching the lungs. Exposure to fine particles can cause short-term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath. Exposure to fine particles can also affect lung function and worsen medical conditions such as asthma and heart disease. Scientific studies have linked increases in daily PM<sub>2.5</sub> exposures with increased respiratory and cardiovascular hospital admissions, emergency department visits and deaths. Studies also suggest that long term exposure to fine particulate matter may be associated with increased rates of chronic bronchitis, reduced lung function and increased mortality from lung cancer and heart disease. People with breathing and heart problems, children and the elderly may be particularly sensitive to PM<sub>2.5</sub>.

There are outdoor and indoor sources of fine particles. Outside, fine particles primarily come from car, truck, bus and off-road vehicle (e.g., construction equipment, snowmobile, locomotive) exhausts, other operations that involve the burning of fuels such as wood, heating oil or coal and natural sources such as forest and grass fires. Fine particles also form from the reaction of gases or droplets in the atmosphere from sources such as power plants. These chemical reactions can occur miles from the original source of the emissions. In New York State, some of the fine particles measured in the air are carried by wind from out-of-state sources. Because fine particles can be carried long distances from their source, events such as wildfires or volcanic eruptions can raise fine particle concentrations hundreds of miles from the event.

PM<sub>2.5</sub> is also produced by common indoor activities. Some indoor sources of fine particles are tobacco smoke, cooking (e.g., frying, sautéing, and broiling), burning candles or oil lamps, and operating fireplaces and fuel-burning space heaters (e.g., kerosene heaters).

The United States Environmental Protection Agency (EPA) established National Ambient Air Quality Standards for PM<sub>2.5</sub> in 1997 and revised them in 2006 and 2012. National Ambient Air Standards are established to be protective of public health. The short-term standard (24-hour or daily average) is 35 micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ) and the long-term standard (annual average) is 12  $\mu\text{g}/\text{m}^3$ . A microgram is a unit of weight. There are a million micrograms in a gram, and a pound is equal to about 450 grams.

Outdoor air levels of fine particles increase during periods of stagnant air (very little wind and air mixing), when the particles are not carried away by wind, or when winds bring polluted air into the state from sources outside the state. In general, as the levels of PM<sub>2.5</sub> in outdoor air increase, the air appears hazy and visibility is reduced. These conditions are similar in appearance to high humidity or fog. The New York State Department Environmental Conservation informs the public whenever fine particle concentrations in outdoor air are expected to be elevated. Every weekday morning the Department of Environmental

Conservation will review weather conditions and data from their air monitoring stations to determine if, for that day or the following day, fine particle levels are expected to exceed levels considered unhealthy for sensitive groups. If it is likely that this level will be exceeded, the agency will contact the media so that a Particulate Matter Health Advisory can be carried on afternoon and evening broadcasts. The Department of Environmental Conservation also provides PM<sub>2.5</sub> monitoring data and PM<sub>2.5</sub> forecasts on its web site.

When outdoor levels of PM<sub>2.5</sub> are elevated, going indoors may reduce your exposure, although some outdoor particles will come indoors. If there are significant indoor sources of PM<sub>2.5</sub>, levels inside may not be lower than outside. Some ways to reduce exposure are to limit indoor and outdoor activities that produce fine particles (for example, burning candles indoors or open burning outdoors) and avoid strenuous activity in areas where fine particle levels are high.

## 22 Precautionary Measures

### 21.1 Avoid using diesel generators:

#### 21.1.1 Ambient noise monitoring status

Andhra University is located in the center of the city. The major source of noise in university is automobile noise. At the main gate of the Campus, human communication and transportation is producing some sound levels. Ambient noise monitoring was carried out in different areas of Andhra University campus like at university campus entry, administration building, and horticulture section. The sampling was carried out using calibrated Sound Level Meter (AZ8921) by logarithmic scale in decibels (dB). The noise readings were collected on the University campus and calculated. The details of noise status in University campus are given in the below table.

#### *Ambient Noise levels in Andhra University*

Sr. No	Department Name	Leq (dB) Day Time
1	MAINGATE–Campus Entry	69
2	Administration	34
3	Community Hall	43

#### Note:

- All parameters expressed in dB (A) and observed under permissible limits.
- Monitoring is carried out during the daytime.

#### **Recommendations**

- **No recommendations can be given in reference to AQI, as university has already achieved its Zenith and it is expected that it will further do better of its own**
- University must try to go as much as achieving Net Zero by reducing its Energy consumption and depending more on New/ Renewable energy.

- By becoming 1<sup>st</sup> Net Zero University of India, it can achieve the goal set by our beloved Prime Minister's dream.
- Also the students of this University can lead the torch of light to show what University has done.

### 22.1.2 Provisions for Differentially abled

Provisions given to the disabled in India:

#### 22.1.2.1 The persons with disabilities (PWD) (equal opportunities, protection of rights and full participation) act, 1995

- Prevention and Early Detection of Disabilities.
- Employment.
- Non-Discrimination.
- Research and Manpower Development.
- Affirmative Action.
- Social Security.
- Grievance Redressal.

#### 22.1.2.2 Rights of a student with a disability

- Academic Institutions cannot discriminate against students with disability. **Students with disability have the right to participate in educational courses or programs, and use educational services and facilities**, on the same basis as students without disability.
- **The 4 categories of disabilities.**
- There are many types of disabilities, but Crow (2008) divides them all into four categories: **visual, auditory, mobility, and cognitive.**
- **The 5 key areas of the disability standards of education.**
- The Disability Standards cover five specific areas of an educational service: **enrolment • participation • curriculum • support services • preventing harassment and victimization.**
- **Assistance for Differentially abled Students**
- The institutes should create special facilities such as **ramps, rails and special toilets**, and make other necessary changes to suit the special needs of differently-abled persons. The construction plans should clearly address the accessibility issues pertaining to disability.

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- Prevention and Early Detection of Disabilities.
- Employment.
- Non-Discrimination.
- Research and Manpower Development.
- Affirmative Action.
- Social Security.
- Grievance Redressal.

## 22.2 *The rights of a student with a disability.*

Schools cannot discriminate against students with disability. **Students with disability have the right to participate in educational courses or programs, and use educational services and facilities**, on the same basis as students without disability.

## 22.3 *4 categories of disabilities.*

There are many types of disabilities, but Crow (2008) divides them all into four categories: **visual, auditory, mobility, and cognitive.**

## 22.4 *5 key areas of the disability standards of education.*

The Disability Standards cover five specific areas of an educational service: **enrolment • participation • curriculum • support services • preventing harassment and victimization.**

## 22.5 *Assistance for Differentially Abled Students*

The institutes should create special facilities such as **ramps, rails and special toilets**, and make other necessary changes to suit the special needs of differently-abled persons. The construction plans should clearly address the accessibility issues pertaining to disability.

Andhra University has already processed a lot for differentially abled staff and students but they can still do a lot.

- Separate parking for differentially abled persons.
- Toilets
- Ramps at all buildings
- And many more options can be looked for

## 23 *CARBON FOOTPRINTS:*

Carbon is the basis of life on mother Earth. It is incorporated into the plants through photosynthesis, consumed by animal species through the food, present in the form of carbon dioxide (CO<sub>2</sub>) in the atmosphere, locked into the rocks like limestone, and compressed into the different fossil fuels such as coal and oil. As CO<sub>2</sub> levels in the atmosphere continue to increase, most climate designs or projects that the oceans of the world and trees will keep soaking up more than half of CO<sub>2</sub>. The plants on land and in the sea, taken up carbon over many years increased the percentage discharged during decay, and this increased carbon became locked away as fossil fuels beneath the surface of the planet. At the start of the 21st century, we have growing concern about global warming, climate change, food security, poverty, and population growth. In the 21<sup>st</sup> century, more carbon has been released into the atmosphere than that has been absorbed. CO<sub>2</sub> is a principal component causing global warming. Atmospheric carbon dioxide levels have increased to 40 % from preindustrial levels to more than 390 parts per million CO<sub>2</sub>. On this background, it is a need of time to cover the research is as inter-related with climate change.

### 23.1 *Carbon footprints*

In today's world, one of the biggest issues faced by all of us is global warming. Global warming refers to an increase in the average global temperature of mother Earth. The

main cause of global warming is an increase in the concentration of greenhouse gases (GHGs) in the atmosphere due to anthropogenic activities and their level is determined with the help of global warming potential (GWP) and expressed as Carbon Footprint (CF). Carbon Footprint is another phenomenon used for GHGs or carbon dioxide emission in terms of CO<sub>2</sub> equivalents. There are various definitions of carbon footprint in literature. But the most recognized definition given by Wiedmann is *“the Carbon footprint is the measure of carbon dioxide emissions directly or indirectly caused by an activity or accumulated over the life stages of a product.”* In other words, *“A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event or product.”*



As Andhra University is considered an institutional organization, various energy resources like electricity, solar rooftop systems are used. It is necessary to calculate the carbon footprint of the University to upgrade the Clean Developmental Mechanism (CDM) in various processes. All the data from the various sources were collected from all the sectors where energy resources are used. The collected data is calculated by using standard emission factors.

### **23.2 Efforts for Carbon Neutrality**

Air pollution is a matter of serious concern on the campus owing to its urban location. Andhra University as a responsible institution understands the importance of its carbon footprint and developed a plan to reduce greenhouse gas emissions in all its activities. Strictly none burning of dried leaves and wastepaper in University.

### **23.3 Electricity carbon footprint**

In the university, electricity is used for various purposes like residential, office use, and laboratories. The total electricity used in the University liberates mass kg of CO<sub>2</sub> per

year. The laboratory equipment consumes the highest electricity which emits a large amount of carbon CO<sub>2</sub> per year. The solar panels are installed on the roof of various buildings produce electricity from solar panels which further saves ample mass of CO<sub>2</sub> per year.

### **23.4 Paper footprint**

The papers are used in the institution for various purposes like exam answer sheets, circulars, notices, office work, etc. The papers are responsible for the emission of CO<sub>2</sub>. The University used a total used 1,765.17 reams of paper which its 3.67 tons of CO<sub>2</sub>. On the University campus, various departments follow paperless methods of communication to reduce the footprint by the use of papers. The various sections on the campus save 13, 48,914 papers per year i.e., 2,697 reams. The paperless work reduces approximately 5.61 tons of CO<sub>2</sub> approximately. A total of 2.80 tons of biomass is saved by paperless communication i.e., green computing.

#### *The total footprint of the University*

The total footprint is the addition of all the footprints, and it is expressed as tons of CO<sub>2</sub> per year. The total footprint of Andhra University is approx. more than 10,000 tons of CO<sub>2</sub> per year approximately. As the university is following the Clean Developmental Mechanism to reduce the emission of CO<sub>2</sub> and green house emission by using solar panels for electricity generation and minimize the paper work at the university reduces of 18.10 tons of CO<sub>2</sub> per year approximately.

### **23.5 Conclusion**

India's CO<sub>2</sub> emission is increased by an estimated 4.6 % in 2017, despite a turbulent year for its economy. The carbon footprint of the nation is measured per person; India's missions are still very low – at only 1.8 tons of CO<sub>2</sub> per capita which is much lower than the world average of 4.2 tons. But those emissions have been increasing steadily, with an average growth rate over the past decade of 6 %. The universities are the organizations which are having large area which consume high quantities of electricity and LPG for many purposes. The Andhra University Campus emits approx. 24,000 tons of CO<sub>2</sub> per year approximately. The present Clean Development Mechanism (CDM) practices to reduce the 18.10 tons CO<sub>2</sub> per year approximately.

### **23.6 Recommendations**

- The food waste generated from university hostel mess, guest house, canteens, and staff quarters should be converted into biogas which can be further utilized for hostel kitchens.
- The solar battery-operated vehicles should be used on the campus to



- overcome the vehicle footprint.
- Green computing or E-work is helping the organization to reduce footprint very effectively.
  - The solar energy-based streetlamps on campus will reduce carbon footprint.
  - The awareness should be made among the faculty, students, and other employees regarding Clean Development Mechanism (CDM) to reduce the consumption of electricity and natural resources.
  - “Carbon Sequestration” survey should be conducted on the campus. Carbon sequestration is a process of converting atmospheric carbon i.e. CO<sub>2</sub> into other sinks of carbon such as vegetation, soil, ocean, etc. in various forms to mitigate global warming. Carbon sequestration is one of the important uses of the Kyoto Protocol.

### **23.7 Carbon Sequestration**

While transforming ourselves from regional universities to global universities, the need of such universities to face the global future challenges and try to find out possible solutions for them. It is a social and environmental responsibility of Government Institutes, Universities, National and International Organizations to respond positively to various global issues at the local level and should collate the generated knowledge in to the society. Global warming and climate change are current environmental issues that need to be addressed scientifically and efficiently. As Universities are provided with skillful human resources supported by analytical infrastructure, it is our duty to bring such ideas in to practice.

## **24 Green Initiatives**

University is located in the area which is one of the important wilder areas of Vishakhapatnam city with its precious biodiversity. It covers an area of about 262 acres. The major portion is covered with vegetation. The university aims to protect and conserve its biodiversity, fresh and clean ambiance through many initiatives. The university has taken the following green initiatives to protect and conserve nature.

### **24.1 Plantation and Nurturing Program**

Many plantation drives are taken by the University on its campus. Every year on 5<sup>th</sup> June i.e. World Environment Day, the University takes Plantation activity. The Horticulture Section looks after tree plantation activities. The trees are watered by students of various Departments. They nurture the settees throughout the year. Students of various departments and students make the plantation and nurturing program successful. A total of 23 plant saplings of different species (like ornamental, fruit and medicinal plant, etc.) were planted in various sites of the University campus during this year's environment day program.



## ***24.2 Green computing practice***

Being an academic institution, papers are used for various purposes like exam answer sheets, circulars, notices, office work, document printing, and Xeroxing. Since the trees are cut for paper manufacturing, the sequestration of carbon is reduced increasing carbon footprint. To cut down the carbon footprint, the university administration and various departments follow paperless methods of communication by using emails, online forms submission, etc. The paperless work was helpful in reducing tons of CO<sub>2</sub>. The tons of biomass are saved by this green computing practice.

### ***24.2.1 Solar Electricity Generation***

Many solar energy projects are in process. University has initiated for wind energy projects also. As a test check, audit team visited Chemical Engineering department and found that whole roof was fitted with solar PV. About 6KW of energy is being generated by Chemical Engineering department against its need of 120KW.

### ***24.2.2 Conferences and workshops on Environmental Sustainability***

Andhra University organizes Conferences and Workshops based on the theme of environmental sustainability.

## 25 Conclusions

Environment Audit is one of the important tools to check the balance of natural resources and their judicious use. Environment auditing is the process of identifying and determining whether institutional practices are eco-friendly and sustainable. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. The main objective to carry out a green audit is to check the green practices followed by the university and to conduct a well-defined audit report to under and whether the university is on the track of sustainable development. After completing the audit procedure of the university for green practices, there are the following conclusions, recommendations, and Environmental Management Plan (EMP) which can be followed by the university in the future for keeping campus environment friendly.

- University takes efforts to dispose of major of waste by proper methods. Green computing, i.e. Online payment systems, online circulars, and examination procedures are helpful for reducing the use of papers and ultimately reducing carbon footprint.
- Reducing the use of one-time use plastic bottles, cups, folders, pens, bouquets, decorative items will be useful to solve the problem of plastic pollution to some extent.
- Biodegradable waste is used efficiently being planned for composting and vermicomposting.
- Use of LED lamps and Tube Lights is already in a big progress and now University is in processes of purchasing Energy efficient electrical appliances also.
- Toilets and bathrooms are consuming more water in the departments. The replacement of old taps can be beneficial for solving this issue. Water metering is the best way to understand the need of the hour. From that we can find out the places where consumption of water can be reduced.
- The overall ambient air quality on the campus is excellent.
- The sound levels on the campus are good.
- Science departments are following the principles of Green Chemistry to reduce chemical waste.

## 25.1 Key Recommendations & Environment Management Plan (EMP)

Following are some of the key recommendations for improving the campus environment and to be considered as Environment Management Plan (EMP).

- An environmental policy document has to be prepared with all the recommendations and current practices carried by the university.
- A frequent visit should be conducted to ensure that the generated waste is measured, monitored, and recorded regularly and information should be made available to the administration.
- The University should develop internal procedures to ensure its compliance with environmental legislation and responsibility should be fixed to carryout it in practice.
- The waste should be reused or recycled at maximum possible places.
- Installation of solar panels and rainwater harvesting system to every terrace of the building will be useful in conserving the natural resources.
- Regular checkups and maintenance of pipes, overhead tanks, and plumbing systems should be done by the engineering section to reduce overflow, leakages, and corrosions.
- Science laboratories large amount of water goes waste during the process of making distilled water; the system should develop to reuse this water for other purposes. The solar distillation unit is installed at the earliest.
- Fresh water not to be used for gardening and washing purposes.
- No such processes or activities were observed at Andhra University which can deteriorate the environmental quality.
- The said University is in continuous efforts to spread the environmental awareness programs among staff and students.
- It was also observed that the said University is keeping the environmental quality at priority in every developmental stage.

*DEVELOPMENT IS AN IMPORTANT ASPECT OF ANY ORGANIZATION, COLLEGE, OR UNIVERSITY. THIS DEVELOPMENT BY ANDHRA UNIVERSITY IS ALWAYS ACHIEVED AT THE EXPENSE OF ENVIRONMENTAL REHABILITATION. WE ARE GLAD TO DECLARE THAT ANDHRA UNIVERSITY IS AN ENVIRONMENT-FRIENDLY UNIVERSITY ALONG WITH MANY GREEN DEVELOPMENT PROCESSES THAT ARE FAIRLY PRACTICED BY THE UNIVERSITY.*

## **26 Hygiene Audit**

A food hygiene audit or food safety audit provides a comprehensive inspection of a food processing facility to evaluate its compliance with established food hygiene and safety standards, as well as a company's specific hygiene policies and practices.

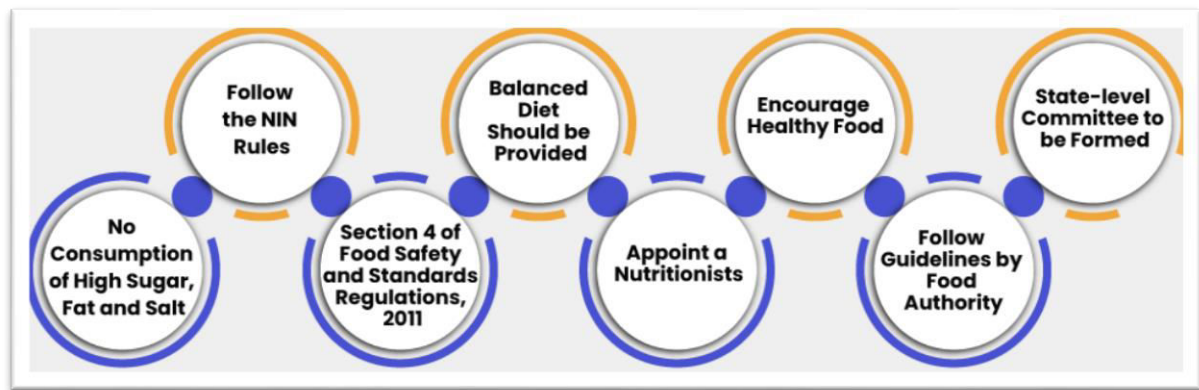
### **26.1 Steps to Conduct a Cleaning Audit:**

1. Define Goals of the Audit.
2. Develop a Tracking and Measurement Tool.
3. Introduction Meeting.
4. Conduct Cleaning and Audit.
5. Retrain Students of Staff Based on Results.
6. Reward or Punish Accordingly.
7. Repeat Audits Until Optimal Results are Achieved.

Hand hygiene audit is the process of making sure that hand hygiene techniques being practiced in healthcare follow recommended guidelines. Hand hygiene audit aims to prevent the spread of infection between healthcare workers and patients through observational inspections of hand washing techniques Environment.

FSSAI is a food regulatory body which contains food license for the different kinds of categories of various food products in India. The FSSAI provides food license for schools and colleges canteen, and these canteens come within the definition of the food business in India. To functionally operate in India, it is compulsory to have [FSSAI License](#) for all the businesses which come under the category of food business in Section 3 (1) (n) of the Food Safety and Standard Act, 2006. Scroll down to check more information regarding Food License for Schools and Colleges Canteen.

Following are some vital points that should be followed by schools and colleges canteen that holds FSSAI License:



- **No Consumption of High Sugar, Fat and Salt:** Foods are having high in sugar, salt, and fat are strictly prohibited or banned and such food cannot be sold to college and school students in canteen or mess or hostels or within 50 meters of the school campus area.
- **Follow the NIN Rules:** As per the NIN rules or guidelines, the NIN ((National Institute of Nutrition School Authority) has to encourage balanced diet consumption in schools and colleges.
- **Section 4 of Food Safety and Standards Regulations, 2011:** The food business operator is compulsory to attain an FSSAI Registration/License as appropriate to them. They must fulfill all the requirements of hygienic and sanitary practices to the foodservice institutions.
- **Balanced Diet should be provided:** As per the Food Safety and Standards Regulations, 2011, the schools and colleges must have to promote safe and healthy food diets amongst school and college students. To convert college canteen/school canteen into *Eat Right School* where the primary aim is to provide safe, nutritious & hygienic food and no food waste as per the specified benchmarks.
- **Appoint Nutritionists:** It is mandatory to appoint Nutritionists and Dietitians attached to the school/college authority to support them regularly in preparing meals of school or college students.
- **Encourage Healthy Food:** In India, all the food business operators should promote healthy foods in schools and colleges, and they should not target a market within a school to sell or sell low diet food anywhere on the school or college campus in the form of a poster, names, logos, etc.
- **Scrutiny:** There should be scrutiny of colleges or schools regularly, to make sure that healthy, safety and hygienic food is served to students.
- **Follow Guidelines by Food Authority:** As per the direction, the Authority of School or College must make sure that the food business operators who are supplying or preparing foods within the colleges or schools follow all the guidelines issued by Food Authority.
- **State-level Committee to be formed:** The school must create a committee by the State Level Advisory Committee to supervise the implementation of food regulation and ensure the availability of safe and healthy food to school children.

Following are some essential documents required for the registration of the canteen owner in college or school are required to submit, to obtain Food License for Schools and Colleges Canteen in India:

- Address proof.

- FSSAI Registration Number.
- Submit a copy of identity proof of the owner such as Aadhar Card, Driving License, Voter's Id, PAN Card, Passport, etc.
- Submit a copy of Incorporation Certificate.
- A detailed list of all the categories of food.
- Submit a copy of Memorandum of Association (MOA) and Articles of Association (AOA).
- A detailed list of all the proposed directors or partners.
- Central License or State License.
- Submit the latest passport size photograph of the owner.
- Submit a NOC or No Objection Certificate from the local authority, but in this case, you need to submit NOC from school/college.

There are three different categories of FSSAI Registration procedure to obtain a Food License for Schools and Colleges Canteen in India and you can check the same below:

### **26.2 Basic FSSAI Registration for Canteen**

- Basic FSSAI Registration is only for those canteens whose annual turnover is not more than or up to Rs. 12 lakhs and they are eligible to obtain food license for schools and colleges canteen under FSSAI License.
- These are a small and medium-sized business.
- FSSAI Certificate is issued to such businesses that get the business an audit and inspection conducted by a Food Safety Inspector or Officer.

### **26.3 FSSAI State License for Canteen**

- This License is only for those canteens whose annual turnover is more than Rs. 12 lakhs and up to Rs. 20 crores.
- FSSAI Certificate is issued to businesses who get the business an audit and inspection conducted by a Food Safety Inspector or Officer.
- They are eligible to State FSSAI/Food License for Schools and colleges canteen under the State Authority.

### **26.4 FSSAI Central License for Canteen**

- This License is only for those canteens whose annual turnover is more than Rs. 20 crores.
- Food Business Operators (FBOs) have got inspected or examined and audited by the Food Safety Officer.
- They can operate their business at PAN India level.
- They are eligible for Central FSSAI Food License for schools and colleges canteens under Central Authority.

### **26.5 Conclusion**

From above, it is concluded that today the school or college students are totally dependent over the food in the schools and colleges canteens. To operate these businesses, the food business operator must obtain a food license for schools and colleges canteen, and it is vital

to maintain hygiene and health over food quality. This FSSAI License is the authenticity proof over their product sold.

Hygiene in Toilets & Washroom Area:  
How do you maintain toilet hygiene?

### ***26.6 Bathroom talk: 5 ways to maintain toilet hygiene***

1. Shut the lid before flushing. Researchers found that with each flush, germs can be released up to 10 inches above toilet seats. ...
2. Keep toilet seats clean. ...
3. Wash hands thoroughly with soap and water before stepping out. ...
4. Dry hands before stepping out. ...
5. Keep the floor dry.

### ***26.7 Importance of toilet hygiene***

The need for latrines and toilets result in an unhealthy environment contaminated by human waste. Without proper sanitation facilities, waste from infected individuals can contaminate a community's land and water, increasing the risk of infection for other individuals.

### ***26.8 Keep a university toilet clean.***

To keep a university toilet clean you need an educated and trained team of cleaners. They need to use good quality bleach products like Domestic and should clean the toilets, toilet bowls, basins and floors at least once a day.

Importance of toilet in university

A lack of access to proper sanitation facilities poses a huge barrier to education as students as well as staffs frequently miss classes due to hygiene-related diseases. Toilets and proper washing stations can help stop the spread of many diseases and parasites such as diarrhea. Without proper cleaning, washrooms can become breeding grounds for germs that can spread disease throughout the school population. In addition to an effective cleaning strategy, schools can fight the dissemination of germs by selecting the right fixtures and equipment.

### ***26.9 Difference between hygiene and Sanitation:***

Sanitation is more than just toilets; it encompasses the facilities, behaviors, and services that prevent diseases caused by contact with human waste. Hygiene refers to behaviors that can improve cleanliness and lead to good health.

### ***26.10 Difference between Washroom and Restroom***

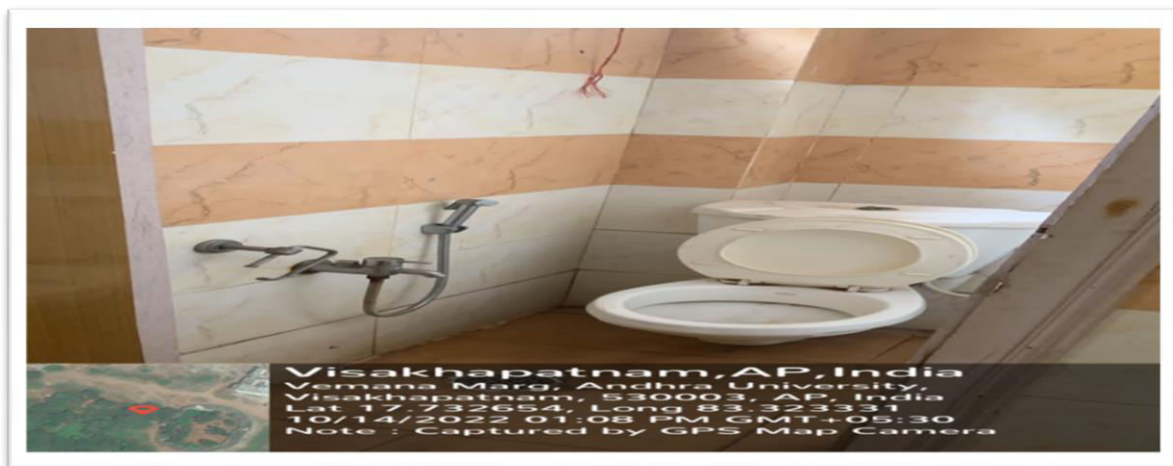




A restroom is a place used to literally take a break, although it also has public convenience facility. A washroom is a place where people can wash as well as relieve themselves. Essentially what we call a bathroom today? Restrooms have hand basins and urinals.

### *26.11 Napkin incinerator at Girls' hostel & Ladies washrooms*

Females always face the problem of discarding sanitary napkins. The idea of installing an incinerator. Main purpose is to maintain hygiene in and around our surroundings be it University, hospitals or girls' hostels and lady's toilet.



Hygienic Toilets



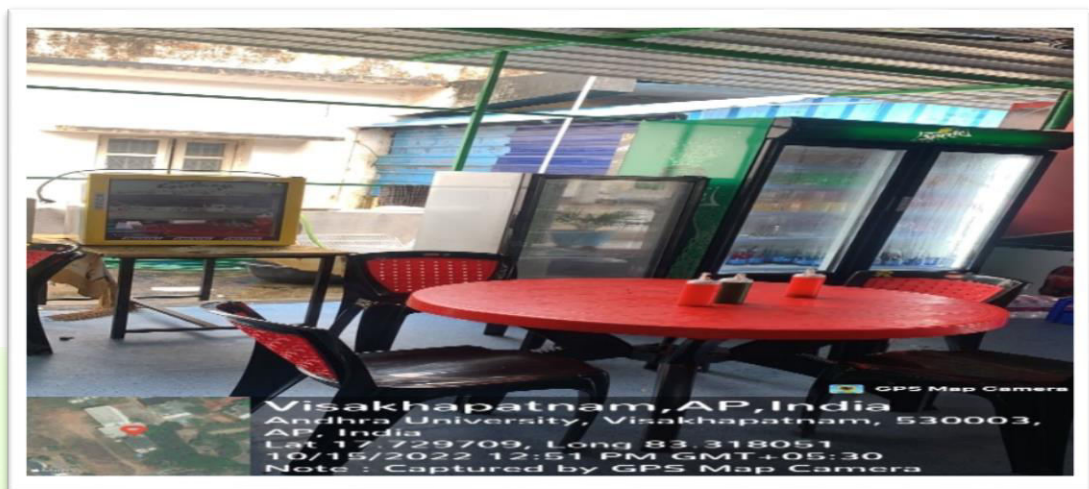
Pictures taken for hygienic wash rooms



Canteen



Canteen



## 27 Recommendations/ Suggestions:

1. *Ground water* at Vishakhapatnam is however safe for drinking as per the *Ground water report* as above but it is recommended to send sample to *State Pollution Control Board Approved Laboratory* for testing.
2. Only 1 water meter is installed at *Platinum Jubilee Guest house*. It is suggested to install at least 1 water meter near each tube well so as to record each day demand. This will help in assessment & reduction of water consumption & also saving cost of energy consumed.
3. From the data provided by *Engineer's office* it is observed that 15.80% of water is unaccounted. This can straight way save 15.8% of revenue spent on water as well as *Electrical energy bill* spent over it in operation of tube well motors.
4. It is recommended to construct a water recycling plant which can recycle

the wastewater (minimum 20%) which can be further utilized for Washing (13.6% of consumption), Gardening (3.85%). So total 17.85% of further water can be saved. In this way total saving of water can be 17.85% + 15.80% = 33.85% of water consumption.

5. More numbers of Waste bins (dry & wet) to be provided preferably for recyclable waste and for food waste. Recyclable waste can fetch revenue and food waste segregation can be utilized in bio-gas plant for producing Methane gas which can be used for mess and canteens as fuel reducing the consumption of gas cylinders.
6. E-Waste to be properly sent to recycler authorized by SPCB. The E-Waste contains precious metals which can be taken out by recyclers and reused by manufacturers.
7. From 1<sup>st</sup> July 2022, single use plastic has been completely banned in India. It is suggested to put boards like **NO PLASTIC ZONE** or any such type of slogans in whole campus area.
8. For Hazardous waste the Department HOD should nominate one of the faculty members, who shall be given responsibility of proper disposal of Hazardous waste.
9. We attended the Dr. Y. V. S Murty Auditorium. There only one firefighting equipment was found. We were told that others are kept in some store room and the key was not available. **It must be checked and ensured that all auditorium halls and other important places firefighting equipment must be available so in case of emergency, it can be properly utilized.**
10. A 50 KLD Sewage Treatment plant cost about Rs. 2.50 lacs. If 2 STP are installed, then we get annual saving of Rs. 9.15 lacs. Hence payback is only 6 months (Approx.).
11. Andhra University has a lush green campus but in the whole area missing water body. If one or two water body is developed, then University campus will become home for many birds and insects who will come for drinking water.
12. A big board should be made just near the front gate so as to depict different types of trees and numbers. Types of species, birds, butterflies etc. coming to the University area. Also % age area of greenery, so as any person while

*entrance will feel the inside climate at very entrance.*

*13. AU can set an example to become 1<sup>st</sup> Net Zero University.*

*14. For differentially abled staffs and students although many steps have been taken by the University but there is much more scope available.*

*15. Trees in the campus are very old also. About 3' of the tree trunk shall be white washed mixed with neem oil so that termite and other insects should not affect the tree.*



# ISO-9001:2015 Certification

Page Display

## Certificate of Registration



This is to certify that Quality Management System of

**GC Consultancy Services**

Flat No. 614, Vasant Enclave, Rajender Nagar, Gorakhnath,  
Gorakhpur-273015 India

is in accordance with the requirements of the following standard

**ISO 9001:2015**  
(Quality Management System)

### SCOPE

Conducting Environmental audits in coordination with CII Green Co Certifications  
which includes Energy, Renewable Energy, Water Conservation,  
Waste Water Management, Life Cycle Assessment

Certificate Number : SCK/01/GCC/22/91/1845

Initial Registration Date : 20-Jul-2022

1<sup>st</sup> Surveillance Date : 20-Jun-2023

2<sup>nd</sup> Surveillance Date : 20-Jun-2024

Certificate Expiry Date : 19-Jul-2025

To verify certificate visit at:

[www.sckcerts.com](http://www.sckcerts.com)

[www.iafcertsearch.org](http://www.iafcertsearch.org)

Issued by SCK Certifications Pvt. Ltd.

*Abhishek*  
Director



Accreditation Board : 3090, Saburn Street, Suite 100, Brea, California 92821-1732, USA

This certificate remains the property of SCK and must be returned to SCK on Cancellation or Suspension of the certificate. Validity of the certificate is subject to successful completion of surveillance audits. Further details regarding the scope of the certificate and the applicability of standard may be obtained by consulting the Organization on [info@sckcerts.com](mailto:info@sckcerts.com)

# ISO-14001:2015 Certification



# ISO-45001:2018 Certification



**Certificate of Registration** 

This is to certify that Occupational Health & Safety Management System of

**GC Consultancy Services**

Flat No. 614, Vasant Enclave, Rajender Nagar, Gorakhnath,  
Gorakhpur-273015 India

is in accordance with the requirements of the following standard

**ISO 45001:2018**  
(Occupational Health & Safety Management System)

**SCOPE**

Conducting Environmental audits in coordination with CII Green Co Certifications  
which includes Energy, Renewable Energy, Water Conservation,  
Waste Water Management, Life Cycle Assessment

Certificate Number : SCK/03/GCC/22/91/1847

**To verify certificate, visit at:**  
[www.sckcerts.com](http://www.sckcerts.com)  
[www.iafcertsearch.org](http://www.iafcertsearch.org)

Initial Registration Date : 20-Jul-2022  
1<sup>st</sup> Surveillance Date : 20-Jun-2023  
2<sup>nd</sup> Surveillance Date : 20-Jun-2024  
Certificate Expiry Date : 19-Jul-2025

Issued by SCK Certifications Pvt. Ltd.  
  
Director

Accreditation Board : 3090, Saburn Street, Suite 100, Brea, California 92821-1732, U.S.A

It is a declaration made by the proprietor of SCK, and must be returned to SCK on Certificate or Suspension of the certificate. Validity of the certificate is subject to successful completion of surveillance audits. All the details regarding the scope of the certificate and the applicability of standard may be obtained by consulting the Registrar at [info@sckcerts.com](mailto:info@sckcerts.com).





भारत सरकार  
Government of India

सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय  
Ministry of Micro, Small and Medium Enterprises



Udyam Registration Number : UDYAM-UP-32-0013224

Type of Enterprise	MICRO	Major Activity	Services
Type of Organisation	Proprietary	Name of Enterprise	G C Consultancy Services
Owner Name	SHRI ASHUTOSH KUMAR SRIVASTAVA	PAN	ANBPS3152K
Do you have GSTIN	Yes	Mobile No.	7007794292
Email Id	gccs4114@gmail.com	Social Category	General
Gender	Male	Specially Abled(DIVYANG)	No
Date of Incorporation	25/02/2022	Date of Commencement of Production/Business	25/02/2022

#### Bank Details

Bank Name	IFS Code	Bank Account Number
axis bank ltd	UTIB0000331	015010100223904

#### Employment Details

Male	Female	Other	Total
3	1	1	5

#### Investment in Plant and Machinery OR Equipment (in Rs.)

S.No.	Financial Year	Enterprise Type	Written Down Value (WDV)	Exclusion of cost of Pollution Control, Research & Development and Industrial Safety Devices	Net Investment in Plant and Machinery OR Equipment(A)-(B)	Total Turnover (A)	Export Turnover (B)	Net Turnover [(A)-(B)]	Is ITR Filled?	ITR Type
1	2020-21	Micro	0.00	0.00	0.00	0.00	0.00	0.00	No	NA
2	2019-20	Micro	0.00	0.00	0.00	0.00	0.00	0.00	No	NA

#### Unit(s) Details

SN	Unit Name	Flat	Building	Village/Town	Block	Road	City	Pin	State	District
1	G C Consultancy Services	614	Vasant Enclave	Gorakhpur	Gorakhpur	Rajender Nagar	Gorakhpur	273015	UTTAR PRADESH	GORAKHPUR

#### Official address of Enterprise

Flat/Door/Block No.	614	Name of Premises/ Building	Vasant Enclave
Village/Town	Gorakhpur	Block	Gorakhpur
Road/Street/Lane	Rajender Nagar	City	Gorakhpur
State	UTTAR PRADESH	District	GORAKHPUR , Pin : 273015
Mobile	7007794292	Email:	gccs4114@gmail.com

#### National Industry Classification Code(S)

S.No.	Nic 2 Digit	Nic 4 Digit	Nic 5 Digit	Activity
1	63 - Information service activities	6399 - Other information service activities n.e.c.	63999 - Other information service activities n.e.c.	Services

Are you interested to get registered on Government e-Market (GeM) Portal	Yes
Are you interested to get registered on TRaDS Portals(one or more)	No
Are you interested to get registered on National Career Service(NCS) Portal	N/A
District Industries Centre	GORAKHPUR ( UTTAR PRADESH )
MSME-DFO	KANPUR ( UTTAR PRADESH )
Date of Udyam Registration	26/02/2022



भारत सरकार  
Government of India  
सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय  
Ministry of Micro, Small and Medium Enterprises



## UDYAM REGISTRATION CERTIFICATE



UDYAM REGISTRATION NUMBER	UDYAM-UP-32-0013224																							
NAME OF ENTERPRISE	G C CONSULTANCY SERVICES																							
TYPE OF ENTERPRISE*	MICRO (Based on FY 2020-21) (MICRO being FY 2019-20)																							
MAJOR ACTIVITY	SERVICES																							
SOCIAL CATEGORY OF ENTREPRENEUR	GENERAL																							
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OFFICIAL ADDRESS OF ENTERPRISE	<table border="1"> <thead> <tr> <th>Pin/Post/Block No.</th> <th>Dist</th> <th>Name of Premises/Building</th> <th>Vasant Estate</th> </tr> </thead> <tbody> <tr> <td>Village/Town</td> <td>Gorakhpur</td> <td>Block</td> <td>Gorakhpur</td> </tr> <tr> <td>Road/Street/Lane</td> <td>Rajpiper Nagar</td> <td>City</td> <td>Gorakhpur</td> </tr> <tr> <td>State</td> <td>UTTAR PRADESH</td> <td>District</td> <td>GORAKHPUR, Pin 273005</td> </tr> <tr> <td>Mobile</td> <td>987794332</td> <td>Email</td> <td>gc04114@gmail.com</td> </tr> </tbody> </table>				Pin/Post/Block No.	Dist	Name of Premises/Building	Vasant Estate	Village/Town	Gorakhpur	Block	Gorakhpur	Road/Street/Lane	Rajpiper Nagar	City	Gorakhpur	State	UTTAR PRADESH	District	GORAKHPUR, Pin 273005	Mobile	987794332	Email	gc04114@gmail.com
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State	UTTAR PRADESH	District	GORAKHPUR, Pin 273005																					
Mobile	987794332	Email	gc04114@gmail.com																					
DATE OF INCORPORATION / REGISTRATION OF ENTERPRISE	15/02/2022																							
DATE OF COMMENCEMENT OF PRODUCTION/BUSINESS	15/02/2022																							
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1	43 - Information services activities	4399 - Other information service activities S.A.	43999 - Other information service activities S.A.	Services																				
DATE OF UDYAM REGISTRATION	16/02/2022																							

\* In case of graduation (upgradation) of status of an enterprise, the benefit of the Government Scheme will be entitled as per the provisions of Notification No. S.O. 2105(E) dated 26.04.2020 issued by the Mo MSME.

Disclaimer: This is computer generated statement, no signature required. Printed from <https://uamregistration.gov.in> & Date of printing- 15/02/2022

For any assistance, you may contact:

1. District Industries Centre: GORAKHPUR (UTTAR PRADESH)
2. MSME-DFO: KANPUR (UTTAR PRADESH)

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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Zoom



## Certificate of Training

TNV hereby certifies that

**ASHUTOSH KUMAR SRIVASTAVA**

Has successfully completed the 40 hours

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

- OH: Occupational Health and Safety
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 45001:2018**

Issue Date: 28<sup>th</sup> Sep. 2021

Certificate Number : 2109281221030101

Authorised Signatory  
(Pragya Singh)

**This course is certified by Exemplar Global vide registration number TN006000**

*Note: The course conforms to the principles and practice of audit 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)*

splay



## Certificate of Training

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

**ISO 14001:2015**

Issue Date: 28<sup>th</sup> Sep. 2021

Certificate Number : 2109280721030101

Authorised Signatory  
(Pragyesh Singh)

This course is certified by Exemplar Global vide registration number TN006000

*Note: The course conforms to the principles and practice of audit 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@isoinc.com*



# Certificate of Training

TNV hereby certifies that

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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

- QM: Quality Management System
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 9001:2015**

Issue Date: 28<sup>th</sup> Jul. 2021

Training Date: 14<sup>th</sup> to 18<sup>th</sup> Jul. 2021

Certificate Number : 2107280221020102

Authorised Signatory  
(Pragya Singh)

**This course is certified by Exemplar Global vide registration number TN001**

*Note: The course conforms to the principles and practices of ISO 9001:2015 systems for compliance with standards. This certificate recognizes the competence of the individual. This certificate is recognized by Exemplar Global. For verification of this certificate, please write to Mail: info@isoindia.com*



Confederation of Indian Industry  
125 Years - Since 1895

This is to certify that

**A K SRIVASTAVA**

is a

**CII Certified Expert in Sustainable Waste Management**

**K S Venkatagiri**

Executive Director  
CII-Godrej GBC

**Pradeep Bhargava**

Chairman  
Environment & Recycling Council

**Hussain Shah**

Chairman  
GreenCo Education (C)



Issued by CII Sohrabji Godrej Green Business Centre

Issued on 11 July 2020

CII GBC-SWM-0720-008



Confederation of Indian Industry

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Sustainability Auditor**

**K S Venkatagiri**

Executive Director  
CII-Godrej GBC

**Pradeep Bhargava**

Chairman  
CII-Green Council







Indian Green Building Council  
C/o. Confederation of Indian Industry  
CII - Sohrabji Godrej Green Business Centre  
Survey No 64, Kothaguda Post, Near HITEC City  
R R District, Hyderabad - 500684  
Tel: 91-40-44185111 Fax: 91-40-44185189  
Email: [igbc@cii.in](mailto:igbc@cii.in)  
Website: [www.greenbusinesscentre.com](http://www.greenbusinesscentre.com) ;  
[www.igbc.in](http://www.igbc.in)

V Suresh  
Chairman

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr Ashutosh Kumar Srivastava** is one of the individual Members of Indian Green

Building Council (IGBC) for the Year Jan 2020 to Dec 2024.

Mr Ashutosh Kumar Srivastava membership number is 'IGBC - IM - 10500131'.

V Suresh



Confederation of Indian Industry  
125 Years: 1895-2020

This is to certify that

**ASHUTOSH KUMAR SRIVASTAVA**

is a

**CII Certified Expert in  
Climate Change &  
Environmental Sustainability**

**K S Venkatagiri**

Executive Director  
CII-Godrej GBC

**Pradeep Bhargava**

Chairman  
Environment & Recycling Council

**Hussain Shariyarr**

Chairman  
GreenCo Education Committee



Issued by CB-Schubert Godrej Green Business Centre

Issued on 10 June 2020

CIIIGBCCECES0420258



Confederation of Indian Industry

## The Indian Green Building Council

hereby certifies that

**Ashutosh Kumar Srivastava**

has successfully demonstrated knowledge on the Green Building Design & Construction, Building Standards & Codes, IGBC Resources & Processes and Green Design Strategies & their Impacts.

required to be awarded the title of

## IGBC Accredited Professional

Handwritten signature of K S Venkatagiri in black ink.

**K S Venkatagiri**

Executive Director  
CII-Godrej GBC

9562

Handwritten signature of V Suresh in black ink.

**V Suresh**

Chairman  
Indian Green Building Council

06 June 2020

Handwritten signature of Gurmit Singh in black ink.

**Gurmit Singh**

Vice-Chairman  
Indian Green Building Council



Confederation of Indian Industry

## The Indian Green Building Council

hereby certifies that

**Sunkara Sree Rohita Swathi**

has successfully demonstrated knowledge on the Green Building, Design & Construction, Building Standards & Codes, IGBC Resources & Processes and Green Design Strategies & their Impacts, required to be awarded the title of

### IGBC Accredited Professional

**K S Venkatagiri**  
Executive Director  
CII-Govt/IGBC

**V Suresh**  
Chairman  
Indian Green Building Council

**Gurmit Singh Arora**  
Non-Chairman  
Indian Green Building Council

1905-41

19, Oct 19



This is a certificate awarded to

**Sree Rohita Swathi Sunkara**

on successfully completing

**Managing Safely**

a course approved and validated by the

**Institution of Occupational Safety and Health**

in association with

**NIST Institute Pvt Ltd**

*Approved Centre: 683*

*Signed on behalf of IOSH*

Chief Executive

Course Organizer



Date: 13 November 2019

Cert No: 704747

Possession of this certificate does not confer exemption from accredited qualifications which lead to membership of IOSH.



## Certificate of Training

TNV hereby certifies that

**SUNKARA SREE ROHITA SWATHI**

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 : 26<sup>th</sup> to 30<sup>th</sup> May. 2021

Certificate Number : 2106170721010138

Authorised Signatory  
(Pragya Sree)

This course is certified by Exemplar Global vide registration number TN0062021

*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*



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- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 9001:2015**

Issue Date: 28<sup>th</sup> Jul. 2021

Training Date: 14<sup>th</sup> to 18<sup>th</sup> Jul. 2021

Certificate Number : 2107280221020105

Authorised Signatory  
(Pragyesh Singh)

This course is certified by Exemplar Global vide registration number TN00

*Note: The course conforms to the principles and practice of India's Management System 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@tnv.in*



nebosh

# NEBOSH International General Certificate in Occupational Health and Safety

This is to certify that

**Sunkara Sree Rohita Swathi**

was awarded this qualification on

06 May 2022

Les Philpott  
Chair

Dee Arp  
Accountable Officer

Master log certificate No: 00624114/1286398

SQA Ref: R630 04



**The National Examination Board in  
Occupational Safety and Health**

Registered in England & Wales No. 2698100  
A Charitable Company Charity No. 1010444





भारत सरकार  
Government of India  
सूक्ष्म, लघु एवं मध्यम उद्यम प्रबन्धनालय  
Ministry of Micro, Small and Medium Enterprises



## UDYAM REGISTRATION CERTIFICATE



Our small hands to  
make you LARGE



<b>UDYAM REGISTRATION NUMBER</b>	UDYAM-UP-32-6013224																							
<b>NAME OF ENTERPRISE</b>	G C CONSULTANCY SERVICES																							
<b>TYPE OF ENTERPRISE *</b>	MICRO ( Based on FY 2020-21 ) (MSME During FY 2019-20)																							
<b>MAJOR ACTIVITY</b>	SERVICES																							
<b>SOCIAL CATEGORY OF ENTREPRENEUR</b>	GENERAL																							
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\* In case of graduation (upgradation) of status of an enterprise, the benefit of the Government Schemes will be entitled as per the provisions of Notification No. S.O. 2020(E) dated 26.06.2020 issued by the MSME.

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For any assistance, you may contact:

1. District Industries Centre: GORAKHPUR (UTTAR PRADESH)
2. MSME-DFO: KANPUR (UTTAR PRADESH)

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