Green Initiatives

Guru Nanak Dev University
Amritsar

राष्ट्रीय मूल्यांकन एवं प्रत्यायन परिषद

विश्वविद्यालय अनुदान आयोग का स्वायत्त संस्थान

NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL

An Autonomous Institution of the University Grants Commission

Certificate of Accreditation

The Executive Committee of the
National Assessment and Accreditation Council
on the recommendation of the duly appointed
Peer Team is pleased to declare the
Guru Nanak Dev University
Amritsar, Punjab as
Accredited
with CGPA of 3.51 on four point scale
at A grade
valid up to December 09, 2021

Date : December 10, 2014

Director

EC(SC)/04/RAR/87

Preserve Protect Environment Save

Er. S.K.Goyal
M.E. (Env.), FIE (India)
Sr. Env. Engineer(Retd.)
Punjab Pollution Control Board(PPCB)

EIA Co-ordinator (QCI)
Chartered Engineer,PPCB

Certificate

Certified that a team of faculty members & students, under the leadership of **Prof. Ashwani Luthra, Director IQAC** of Guru Nanak Dev University, Amritsar has conducted a detailed **Environmental Green Audit of various Green Initiatives taken by the university** covering different aspects such as Green Cover, Green Mobility, Air Quality Monitoring, Water and Wastewater Management, Green Energy Initiatives, Solid Waste Management, Bio-Medical Waste Management, and E-Waste Management, for the preservation and protection of environment in its campus. Data and credentials in the report have been scrutinised and are found **Satisfactory**.

Efforts made by the leadership, faculty and students of the University towards environment and sustainability are commendable and worth appreciating.

Dated: NOV.25,2021

(Er. Samarjit K. Goyal)
Chartered Engineer
Pb Pollution Control Board

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LEAVES OF IMPORTANT SURVIVAL TREES IN INDIA — MAHUA, KHEJDI, ALDER, PALMYRA AND OAK

November 29, 2021

The Coordinator
Centre for Sustainable Habitat
Guru Nanak Dev University
Amritsar

Subject: Certification for different Audits under Green Campus Initiatives

Dear Sir,

From the past six years, Centre for Science and Environment (CSE) and Guru Nanak Dev University (GNDU) Amritsar have been working together on CSE's Green Campus Initiative and audit programme. Under this engagement, CSE has supervised multiple environmental audits and trained the faculty, staff and students at GNDU as well as other universities and colleges across India. The results and outcomes of this engagement have been published by CSE in multiple reports such as 'A Green Campus Compendium: Incubation, Experimentation and Demonstration of a Green Future' and 'Green Campus Movement'. Appreciation letters have also been shared at the various stages of this programme. CSE appreciates that the faculty at GNDU has prepared the following audit reports:

1. Green Cover of GNDU
2. Green Mobility Initiatives
3. Air Quality Monitoring
4. Liquid Waste Management
5. Green Energy Initiatives
6. Solid Waste Management
7. Bio-Medical Waste Management
8. E-Waste Management

CSE commends GNDU's efforts towards realising Sustainable Development Goals and extends its full support and expertise in its future endeavours.

Yours' cordially,

Rajneesh Sareen

Rajneesh Sareen
Programme Director
Sustainable Buildings and Habitat Programme
Centre for Science and Environment

GURU NANAK DEV UNIVERSITY

With the glorious history of past fifty years, Guru Nanak Dev University was established at Amritsar on November 24, 1969 to mark the Birth Quincentenary of Sri Guru Nanak Dev Ji, the apostle of universal brotherhood, truthfulness, non-violence, compassion, tolerance, harmony, humanity, strict observance of moral & ethical values in daily life, who is also revered as the founder of Sikhism. It won't be an exaggeration to state that His teachings and preaching & His own personal life are perfect examples to be emulated by the entire mankind even after about four and half a centuries and will remain so eternally. Ever since its foundation the endeavour of the university has always been to meet the objectives enshrined in the Guru Nanak Dev University Act 1969, which emphasized that the new University would make provision for imparting education and promoting research in the humanities, learned professions, sciences, especially of applied nature and technology. Studies and research on the life and teachings of Guru Nanak, in addition to working towards the promotion of Punjabi language and spreading education among educationally backward classes and communities are the other commitments. In consonance with these expectations, the university in its eventful history of 50 years has taken long strides in spreading the message of Guru Nanak Dev ji and promoting education in such fields as Science, Arts, Management, Information Technology, Industrial Technology, Environment, Planning and Architecture. To fulfil its commitment, tuition fee charged from the students of the Guru Nanak Studies and the School of Punjabi Studies departments has been waived. The UGC conferred this University with status of "University with Potential for Excellence" in 2012. The National Assessment and Accreditation Council (NAAC), Bangalore in November 2014 reaccredited the university in 3rd cycle with CGPA of 3.51 out of 4 point scale at "A++" grade, the highest in the region.

Guru Nanak Dev University is a high performing state public university as it has improved its ranking from 80 in 2017 to 51 in 2020 among all Central, Public and Private Universities in the country (NIRF, MHRD, GoI). It is reckoned among top 9% universities of the world and top 10 state public universities of India by Centre for World University Ranking (CWUR), a leading international agency engaged in grading the top ranking universities world-wide since 2012. QS I-GAUGE Rating System has rated the university in the Diamond Category in the field of 'research, faculty quality and infrastructure' by the. It was also shortlisted for the University of the Year Award in the 16th FICCI Higher Education Summit 2021 organized by FICCI jointly with the Ministry of Education and Ministry of Commerce & Industry, Government of India. High quality research has improved the H-index of the university from 64 to 119 with top 10 percent highly cited papers in Scopus. The university is placed among the top 4 Institutions in Punjab and 10 Institutions in North India by Nature Index,

The University today boasts of 43 teaching departments at the Campus and 149 affiliated colleges, 16 Constituent & University Colleges and 53 Associate Institutes, many of which are located in the rural areas. The university has always strived hard to make the benefits of higher education accessible to the rural masses. More than twenty thousand students, an overwhelming majority of them being women, are enrolled in various Departments at University Campus and Constituent Colleges. On-line admission,

on-line counselling, on-line re-evaluation, introduction of Credit Based Continuous Evaluation Grading System etc. are a few hallmarks of the university. All the results have been computerized and OMR (Optical Magnetic Recognition) system is being used to bring in more efficiency and transparency. This is the first University in the region to have computerized its examination and registration system. The students now have an all-time access to their results through SMS service. It acts as a model higher education institution for digital initiatives like e-office management system, digital library, Wi-Fi enabled campus, high speed online teaching modules, and smart classrooms to name a few.

Academically also, the university has carved a niche for itself in the field of Higher Education in the country. Our University is recognized as one of the leading institutions in North India in the domain of Science and Technology. Many coveted projects from the apex bodies like the DST, CSIR, BARC and other organizations worth crores of rupees have been awarded to our faculty members. One of the four Nodal Calibration Centres established by Bhabha Atomic Research Centre is set up at our campus. The Centre of Emerging Life Sciences equipped with the state-of-the-art scientific instruments worth crores of rupees, well-maintained Botanical Garden, Department of Sports Medicine & Physiotherapy are a few of the jewels in the crown of the university. To more strengthen the university infrastructure and to prepare students for employments, computer lab with the help of TCS is also established. Further, the UGC has granted the University the Centre with Potential for Excellence in Life Sciences and Centre for Advanced Study in Chemistry.

In the field of culture and sports also, the achievements of the university are noteworthy. The university has been national Champion for 10 times & the winner of the North-Zone-Inter-Varsity Cultural Championship for 13 times. The winning of the coveted Maulana Abul Kalam Azad Trophy, the highest sports award for a university in the country, for a record number of 23 times, speaks volumes about its supremacy in the field of sports. An Astro Turf for hockey, a swimming pool of international standards, a velodrome, a Gymnasium hall, shooting range & many other state-of-the art sports facilities are the prized possessions of the university. The Lifelong Learning Department of the university is successfully catering to the female folk of the region to make them self-dependent by offering various skill development programmes. The Track record of employment of our students by big business Houses and Multi-National Companies has been very satisfactory. Our students of engineering, management and commerce field are employed by companies in India and abroad. They are all contributing to the creditworthiness of the University by their hard work and diligence. In the last year alone, almost all our engineering and management students were recruited by various companies through campus placements. It goes without saying that all these achievements would not have been achieved, but for the heart and soul put in by the students, faculty members, and administration of the university. Undoubtedly, the university remains committed to achieve the lofty goals, for which it was founded after the name of Sri Guru Nanak Dev Ji.

The university is known for its GREEN CAMPUS initiatives in the field of energy, water, solid waste management, micro mobility and health and hygiene. Some of the key initiatives of the university are energy efficient buildings, rooftop solar energy plant, solar water heaters, censor based urinals, toilets and wash basins, maintenance of lawns as water recharge systems, rooftop rainwater harvesting, on campus sewerage water treatment plant, organic waste management through bio-gas plant and vermin-compositing, natural processing to convert agro-waste into compost, involvement in recycling and reuse of paper, plastic, mettle and other waste, efficient medical waste management, regular thickening of tree cover by planning tree each year, making the campus car free, facilitating the students, staff and the visitors by free of charge e-vehicle facility for micro mobility within the campus, developing lush green covered footpaths, regular sweeping of the roads and buildings at least twice a day and regular disinfectant spray to help the university bag the second cleanest State University in India awarded by the Ministry of Human Resource Development, Government of India under Swachh Campus Ranking for the last two years continuously.

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Green Cover of GNDU

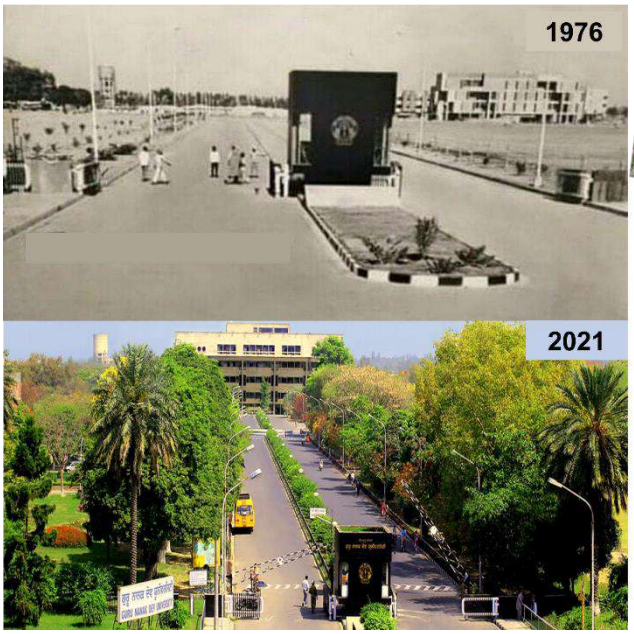
Guru Nanak Dev University
Amritsar

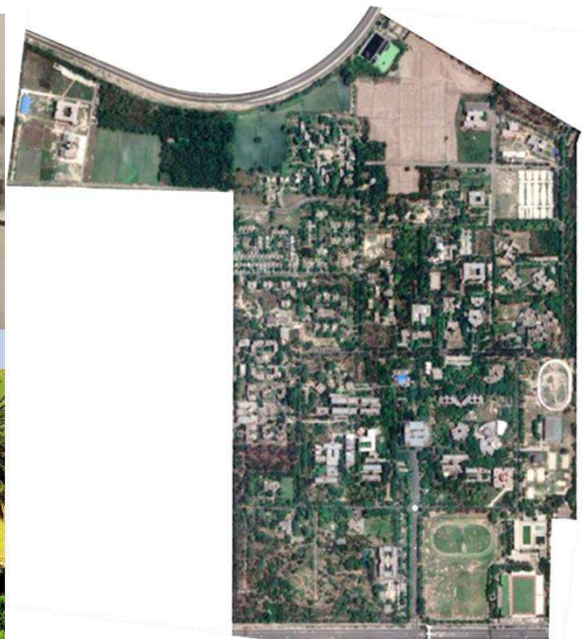
Preface

Guru Nanak Dev University Campus is known for its lush green landscape. It encases variety of green, ornamental and medicinal trees and shrubs. A team led by Dr. Avinash Nagpal, Professor, Botanical and Environmental Sciences and Dr. Jaswinder Singh Bilga, Consultant (Horticulture) along with their students and staff have attempted to audit the tree cover of the University for Internal Quality Assurance Cell, GNDU. The report showcases the unique work to identify the varieties of trees and shrubs planted in the lawns, botanical garden and other forest lands of the university.

1. The Context

Green spaces are known as the lungs on the earth as they freshen the air and make the mankind live a healthy life. Guru Nanak Dev University in Amritsar acts as a huge lung space for the city due to its lush green cover of variety of trees, shrubs and other plants. Once a barren land has been converted into a green parcel having thick green cover of trees and green lawns. Continuous plantation of trees each year presents it as a models of rigorous effort towards reducing the carbon footprints to meet the targets of sustainable development goal number 13 i.e. climate change. The vistas and avenues created by thick tree cover along its roads present spectacular views and walk throughs in the campus.





2. Land Use and Green Spaces

Majority of the land area of the university is kept under green cover. Only 37.58 acres out of 500 acres of the total land of the campus is built. The remaining 462.42 acres, nearly 92.50%, is kept as green. The green parcels consist of parks, lawns, play grounds, agricultural lands, road berms, forest patches, and the botanical garden. The botanical garden of the university was established in 1975 and is spread in 24.71 acres of land. It has about 500 species of trees, shrubs and medicinal plants. It houses open air theatre, lily pool, aquatic pond, fern house and herbal garden. Some of the glimpses of green spaces of the campus are as under.

Glimpses of Tree Cover around Buildings of the University

Glimpses of Tree Cover along Roads of the University

Glimpses of Romanticism of Footpaths

Glimpses of Lawns of the University

3. Tree Audit

The university is a place to witness different varieties of trees and shrubs. About 143 spices of trees and shrubs have been identified in the campus (refer table 1).

Table 1: List of Trees and Shrubs in GNDU Campus

S. No.	Botanical Name of the Plant	Common Name	Approx. No. of Trees/ Shrubs
1.	*Acacia auriculaeformis*	Australian Kikar	75
2.	*Aegle marmelos*	Bael	94
3.	*Ailanthus sp.**	Tree Of Heaven	1
4.	*Albizia procera*	White Siris	28
5.	*Albizia lebbeck*	Sareen	48
6.	*Alstonia scholaris*	Sat Pati	1080
7.	*Acacia nilotica*	Kikar	15
8.	*Araucaria cunninghamii*	Christmas Tree	44
9.	*Artocarpus hetrophyllus*	Jack Fruit	8
10.	*Azadirachta indica*	Neem	240
11.	*Bambusa ventricosa*	Budda Bamboo	8
12.	*Bambusa vulgaris*	Yellow Bamboo	22
13.	*Bauhinia tomentosa**	Yellow Bauhinia	03
14.	*Bauhinia purpurea*	Lal Kachnar/ Purple Bauhinia	38
15.	*Bauhinia variegata*	Kachnar	183
16.	*Bischofia Javanica*	Bishop Wood Tree/ Java Cedar	15
17.	*Bombax ceiba*	Simbal/ Red Silk Cotton Tree	156
18.	*Bouganvillea glabra*	Baugan Bel	1400
19.	*Butea monosperma*	Palash/ Dhak/ Flame Of Forest	508
20.	*Caesalpinia pulcherrima*	Krishna-Charan/ Peacock Flower	5
21.	*Callistemon lanceolatus*	Bottle Brush	381
22.	*Calliandra tweedi*	Red Tassel Flower	32
23.	*Camphora sp.*	Camphor Tree	3
24.	*Carica papaya*	Papita	142
25.	*Coriaria nepalensis**	Masuri Berry	10
26.	*Caryota urens*	Fishtail Palm	28
27.	*Cassia biflora**	Desert Cassia	4
28.	*Cassia fistula*	Amaltas	550
29.	*Cassia glabra*	Glabra	61
30.	*Cassia glauca*	Pila Amaltas	600
31.	*Cassia javanica*	Java Cassia	6
32.	*Cassia siamea*	Seemia/ Kassod	94
33.	*Casuarina equisetifolia*	Junglisaru/ Beef Wood/ Whistling Pine	32
34.	*Cedrela toona*	Tun/ Chitti Sirinh	61
35.	*Cestrum nocturnum*	Rat Ki Rani	345
36.	*Chukrasia tabularis*	Indian Mahogany/Chikrasi	717
37.	*Citrus limon*	Lemon	192
38.	*Citrus aurantium**	Bitter Orange	17
39.	*Citurs jambhiri*	Jambhiri/ Rough Lemon/Jati-Khatti	47
40.	*Clerodendron inerme*	Sankuppi/ Wild Jasmine	1400
41.	*Combretum indicum**	Madhu Malati/ Chinese Honeysuckle	12
42.	*Cordia dichotoma*	Lasooda	75
43.	*Cupressus sempervirens**	Mediterranean Cypress	60
44.	*Cycas circinalis*	Queen Sago	15
45.	*Cycas Revoluta*	Sago Palm	4
46.	*Dalbergia sissoo*	Sheesam	3100
47.	*Delonix regia*	Gulmoher	197

48.	*Dendrocalamus strictus*	Male Bamboo	244
49.	*Dillenia indica*	Chalta/ Elephant Apple	8
50.	*Diospyros spp.**		10
51.	*Dypsis lutescens*	Areca Palm/ Butterfly Palm	27
52.	*Erythrina indica**	Indian Coral Tree	2
53.	*Embilica officinalis*	Amla	52
54.	*Eugenia jambolana*	Jambolan/Java Plum	96
55.	*Eucalyptus sp.*	Safeda	5460
56.	*Ficus benghalensis*	Bodar/ Bargad/ Banyan Tree	149
57.	*Ficus benjamina*	Weeping Fig/ Pukar	191
58.	*Ficus blackeana*		9
59.	*Ficus elastica*	Rubber Tree	61
60.	*Ficus goldiana*		28
61.	*Ficus infectoria*	Pilkhan/ White Fig	78
62.	*Ficus lyrata**	Fiddle Leaf Fig	04
63.	*Ficus panda*		50
64.	*Ficus religiosa*	Pipal	161
65.	*Ficus retusa*	Kamarup/ Laurel Fig	229
66.	*Galphimia gracilis**	Gold Shower	7
67.	*Gardenia jasminoides*	Gandhraj/ Cape Jasmine	52
68.	*Gmelina asiatica*	Nag-Phul	24
69.	*Grevillea robusta*	Silver-Oak	190
70.	*Grewia asiatica*	Phalsa	17
71.	*Hamelia patens*	Hamelia/Scarlet Bush	470
72.	*Hibiscus rosa-sinensis*	China Rose	1400
73.	*Hibiscus mutabilis*	Cotton Rose	50
74.	*Hyophorbe lagenicaulis*	Champangne Palm	31
75.	*Ixora chinensis*	Chinese Ixora	02
76.	*Jacaranda mimosifolia*	Neeli Gulmohur	307
77.	*Jatropha curcas*	Biodiesel Plant	6
78.	*Jatropha panduraefolia*	Bio-Diesel Plant	296
79.	*Kigelia pinnata*	Balam Khira/ Sausage Tree	66
80.	*Koelreuteria paniculata*	Gulabi Neem	89
81.	*Lagerstroemia indica*	Saoni/ Crape Myrtle	78
82.	*Lagerstroemia speciosa*	Jaral/ Giant Crape Myrtle	29
83.	*Lawsonia inermis*	Mehndi	292
84.	*Livistonia chinensis*	Chinese Palm	146
85.	*Leucaena leucocephala*	Lamtoro/ Safed Babool/ Wild Tamarind	936
86.	*Madhuca indica*	Madua	16
87.	*Magnolia grandiflora*	Him Champa	5
88.	*Mangifera indica*	Aam	125
89.	*Melia azadirach*	Dhrek	306
90.	*Michelia sp.*	Champika	12
91.	*Millingtonia hortensis*	Neem Chameli/ Indian Cork Tree	5
92.	*Milettia ovalifolia*	Moulmein Rose Wood	27
93.	*Mimusops elegani*	Morshree/ Spanish Cherry	70
94.	*Mimusops hexandra*	Khirni Tree	3
95.	*Morus nigra*	Shahtoot/Black Mulberry	1203
96.	*Morus alba*	White Mulberry	178
97.	*Moringa oleifera*	Sejana/ Drumstick Tree	33
98.	*Murraya exotica*	Kamini/ Orange Jasmine	363
99.	*Murraya koenigii*	Kadi Pata	377
100.	*Neolamarckia cadamba*	Kadam	41
101.	*Nerium oleander*	Kanel/ Kaner	750
102.	*Ochna squarrosa*	Ramdhan Champa/ Golden Champak	103
103.	*Oncoba Spinosa*	Fried Egg Tree	4

104.	*Oreodoxa regia*	Florida Royal Palm	19
105.	*Oroxylum indica*	Broken Bone Plant/ Bhut Vriksha	9
106.	*Parkinsonia aculeata*	Vilayti Kikar/ Jellybean Tree	2
107.	*Phoenix sp.*	Khajur	19
108.	*Pisonia grandis*	Lettuce Tree, Cabbage Tree	7
109.	*Pinus roxburghii*	Chir	9
110.	*Platanus orientalis*	Chinar	12
111.	*Platycladus orientalis*	Thuja/ Morpankhi	650
112.	*Plumbago capensis*	Nila Chitrak	60
113.	*Plumeria alba*	Frangipani	74
114.	*Plumeria rubra*	Temple Tree	50
115.	*Polyalthia sp.*	False Ashoka	210
116.	*Pongamia sp.*	Shukchain	732
117.	*Prunus domestica*	Alu Bukhara/ Plum	46
118.	*Psidium guajava*	Amrood	406
119.	*Pterospermum acerifolium*	Kanak Champa/ Muchkund	162
120.	*Pterospermum xylocarpum**	Tada	2
121.	*Punica granatum*	Anar	356
122.	*Putranjiva roxburghii*	Putran-Jiva	115
123.	*Ravenala madagascariensis*	Traveler's Palm	12
124.	*Roystonia regia**	Florida Royal Palm	11
125.	*Salix babylonica**	Weeping Willow	10
126.	*Sapindus mukorossi*	Reetha	15
127.	*Stercularia alata*	Buddha Coconut	14
128.	*Schleichera oleosa*	Kusum	331
129.	*Swietenia mahagoni*	American Mahogany	30
130.	*Syzygium cumini*	Jamun	900
131.	*Tabebuia argentea*	Golden Bell	100
132.	*Tabernaemontana sp.*	Pin Wheel Flower	1180
133.	*Tecoma stans*	Piliya/ Yellow Trumpetbush	30
134.	*Tectona grandis*	Teak	170
135.	*Terminalia arjuna*	Arjun	355
136.	*Terminalia bellerica*	Bahera	374
137.	*Terminalia chebula*	Harad	7
138.	*Thevetia neriifolia*	Pili Kaner	910
139.	*Terminalia ivorensis*	Black Afara	70
140.	Other Coniferous Sp.		50
141.	Different Species Of Palms		50
142.	*Wodyetia bifurcata*	Foxtail Palm	60
143.	*Ziziphus mauritiana*	Ber	135
Total			34878

*Only in Botanical Garden

4. Glimpses of Spices of Trees

Cassia fistula

Mangifera indica

Terminalia arjuna

Polyalthia longifolia

Morus alba

Ficus religiosa

Acacia auriculiformis

Tabernaemontana divaricata

Ficus retusa

Pongamia glabra

Delonix regia

Thevetia neriifolia

Callistemon lanceolatus

Pterospermum acerifolium

Psidium guajava

Bauhinia variegata

Chukrasia tabularis

Bauhinia purpurea

Aegle marmelo

Cassia javanica

Citrus limon

Albizzia lebbeck

Plumeria rubra

Bombax ceiba

GREEN MOBILITY INITIATIVES

Guru Nanak Dev University
Amritsar

Preface

Guru Nanak Dev University Campus is the pioneer to introduce green mobility initiatives within its region. Introduction of bicycles and electric buses to facilitate the movement of students, staff and the visitors of the university is a unique effort towards attaining the targets of sustainable development goals. Technically constructed coloured footpaths attract and encourage many of them to walk under lush green tree cover along them. An audit of green mobility has been prepared for Internal Quality Assurance Cell, GNDU jointly by Dr. Ashwani Luthra, (Professor) and Dr. Kiran Sandhu (Associate Professor) of Guru Ramdas School of Planning, GNDU. The report showcases the initiatives of the university with the aim to reduce its contribution towards carbon footprints.

1. THE CONTEXT

The University has about 500 employees and 9000 students with mobility needs of arriving to the University from outside the campus as well as reaching their respective departmental buildings and being able to visit other places in the campus as required. Prior to implementation of the green mobility campus, the ever increasing number of motor vehicles and two vehicles in the University was posing a grave problem of vehicular noise, air pollution and increasing concretization of spaces for parking. Examining the problems arising from plying of motorized vehicles on campus, the leadership in consultation with an expert group prepared a blueprint for introducing a paradigm shift towards green mobility in the next few years time. Accordingly a number of path breaking initiatives were launched that have been instrumental in reducing vehicular influx on campus and creating mobility sans all its damaging impacts. Truly the campus has emerged as a model of green mobility that can be replicated in other institutions across the country.

2. OBJECTIVES OF THE PRACTICE

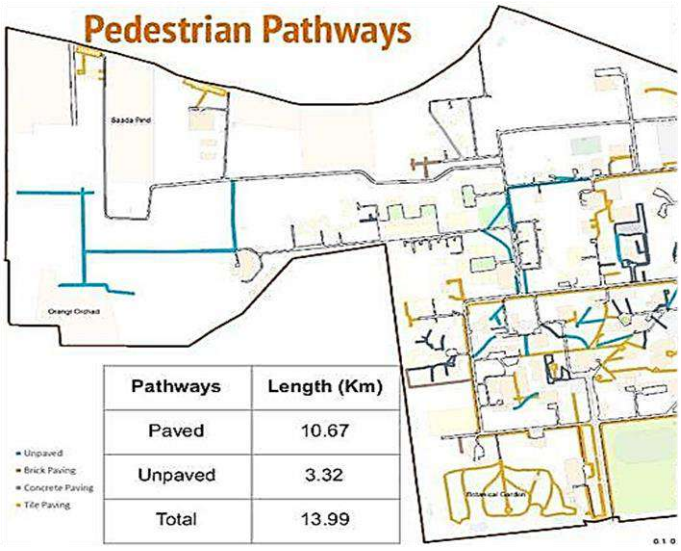
The principle objective of pursuing green mobility in the campus is to reduce the harmful vehicular emissions and thereby the carbon footprint of the University in keeping with the principles of sustainable transport where pedestrianization, cycling and other ecological modes get priority over motorized transport. By doing so the University endeavours to demonstrate that green mobility is realistic, attainable and can deliver significant short and long terms gains in reducing pollution, enhancing health of residents, reducing fuel consumption, reducing heat island effects and influence micro-climate without compromising on mobility requirements of the campus residents and visitors.

3. THE PRACTICE

'Sustainability is no longer about doing less harm. It is about doing more good.' In tune with this maxim, the University has implemented the following practices to achieve its objective of *high mobility and accessibility through green transport interventions.* As such the following green transport interventions have been adopted in the University.

3.1. Construction of Walkways and Pedestrian Precincts

In the last five years, prioritising and promoting pedestrian behaviours in the campus, the University has created a network of 14 kms of footpaths and walkways throughout the campus. Besides the footpaths that form a part of the road right of way, direct route walkways are strategically constructed to encourage pedestrian mobility over vehicular use. The University hostels and residential pathways are constructed of dull red and yellow textured concrete tiles that meet aesthetic aspirations, are visually attractive and walkable besides meeting the standards of pavement design in terms of widths and pedestrian flows. Resultantly pedestrian movement has increased substantially with students, staff members and even visitors resorting to walk and experience the pleasant serene environs rather than using motorized vehicles. A mix of evergreen and deciduous trees planted strategically along the walkways ensure



Pathways	Length (Km)
Paved	10.67
Unpaved	3.32
Total	13.99

shade during intense summer and are therefore usable round the year. Also support infrastructure like benches have been placed along walkways and footpaths as rest spaces which encourages pedestrian mobility.

3.2. Construction of Peripheral Parking Lots

The university was experiencing influx of two-wheelers and cars in large volumes on its campus. Its parking lots used to be full and the vehicles could be seen parked along its roads. Movement of these vehicles within the campus was contributing to high amount of carbon footprints. Evidently, it asked for green mobility initiatives to be taken by the university to model it as a green campus.

Thus, it was decided to make the campus vehicle free. However, after looking into different aspects, it was decided that the cars of the students and the visitors will be parked in two mega parking lots constructed adjoining the front and back gates of the University. This has led to

creation of parking and vehicle free administrative and academic zones and also reduced the carbon footprints significantly through reduced presence of high volumes of vehicles and on all its roads. These two parking lots of the size 1.77 and 3.06 acres, have a combined capacity of 762 four wheelers and 557 two wheelers. Students, visitors and employees park their vehicles in these parking lots and walk to the departments through connected walkways. Restricting the vehicles on the University gate has ensured minimal noise and air pollution and a negligible vehicular movement on the inner roads of the University.



Boom barriers are installed at the entry gate of the university to direct the cars and two-wneelers of the students and the visitors into the parking lots. Also, many other such barriers are installed at strategic location within the university to enhance the safety and security of the campus is endured by checking the entry of the outside vehicles.

3.3. Introduction of E-Rickshaw and Cycle Mobility

In 2018, the University introduced the *Cycle on Rent* concept by inking a pact with the Hexi Cycle Mobility Company. With this, the University earned the distinction of becoming the first University Campus in India to launch an *avant-garde* initiative of this nature. Three hundred Hexi Smart Bicycles were distributed at all strategic locations in a special cycle parking space with the provision of using the same for a nominal rent facilitated through a special app using a mobile number. The initiative became immensely popular amongst the students and staff. However, the Covid-19 lockdown that led to closure of the University for more than a year dealt a severe blow to the initiative. However, with the resumption of offline education mode and normalization of university activities, the University is in talks with the UK based organisation *Cities forum* for reintroduction of such an initiative.

3.4. Introduction of E-Carts

Eight eco-friendly electric carts have been introduced to meet the micro mobility requirements within the campus. Each bus is powered by a bank of 12, 6V batteries (72 V system). The fourteen-seater buses transport 112 passengers at a point of time and the bus stops and charging stations have been purposefully located. These carts operate at schooled timings on specific routes to serve the students and the visitors to the university free of cost. By the implementation of this system noiseless, zero carbon emission mobility has become a reality. The mode is turning out to be very popular amongst the students and staff alike.

3.5. University Buses for Mobility Facilitation

In addition to the above initiatives, the University has since long been running its fleet of four buses to bring down dependency of the University staff and students on personal modes and promote use of mass transport as the buses for home to work trips between different locations in the city and the campus. These buses transport the staff and the students of the university three times a day on work days. About 150 university passengers travel by these buses daily.

4. EVIDENCE OF SUCCESS

The University has become one of the first in the country to take such radical decisions for reducing carbon emissions through the implementation of green mobility initiatives.

4.1. Environmental Sustainability

Drastic reduction of vehicular traffic within the University is a direct result of this initiative as more and more resident population has shifted to pedestrian, cycling and e-bus modes. Favourable infrastructure and awareness campaigns have led to change of user behaviours in favour of non motorised and eco friendly transport. The University roads remain clean, dustless, noiseless and odourless because of less plying of vehicles post introduction of green mobility measures.

4.2. Social Sustainability

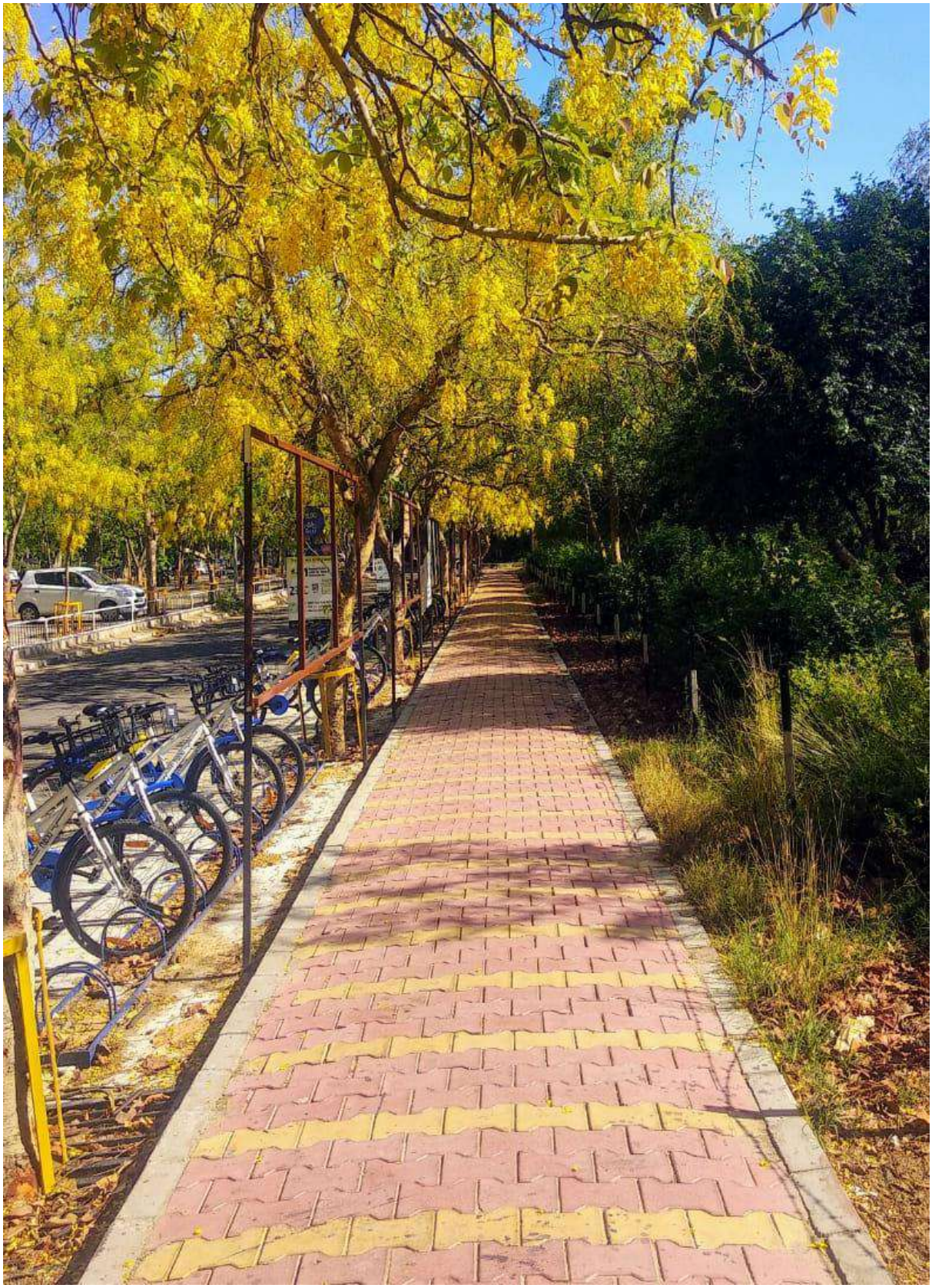
The initiative has helped promote a sense of pride, belonging and identity to the campus population who have embraced the initiatives in a big way thus supporting the University Authorities through their enthusiasm and support. Also the initiatives have generated employment for eight people as e-bus drivers as also paved way for more employment opportunities to arise in near future with its expansion and the reintroduction of Hexi like organised bicycling facilities.

4.3. Economic Sustainability

Drop in fuel consumption of personal vehicles through pedestrian/cycling endeavours and the e-buses is a prime benefit underpinning economic sustainability of the initiative. For instant, in case of the e-buses, **e**stimated energy consumption per year for charging 8 e-buses, for average 4 hours per day for 180 days comes out to be 2x4x8x180 = 11,520 kWh. Though one may argue that the use of e-buses may lead to electricity load for charging the batteries but the fact remains that this energy consumption is easily offset by the saving in diesel cost.

5. PROBLEMS ENCOUNTERED AND RESOURCES REQUIRED

In such like decisions it may be mentioned that transitions are not easy and it takes a lot of time and effort to construct infrastructures and implement such measures. The University also faced some roadblocks at an initial stage wherein the local city students were resisting the application of personal vehicle mobility and parking restrictions. However with competent intervention of the University Authorities, the students were convinced of its benefits and briefed of their and the University's collective responsibility to reduce the carbon footprint. The second challenge came with the country going into an indefinite lockdown which had a detrimental impact on the Hexi cycle operations in the campus to the extent that the company had to withdraw operations in the absence of student strength. However, with the campus resuming normal operations and returning to full student strength, negotiations are on with Cities Forum, UK and it is expected that the cycling initiatives shall restart soon.



Prepared by
Internal Quality Assurance Cell, Guru Nanak Dev University, Amritsar

Air Quality Monitoring of
Guru Nanak Dev University, Amritsar

Guru Nanak Dev University
Amritsar

Preface

Monitoring the quality of air at Guru Nanak Dev University Campus is being carried on periodic basis so that its contribution to carbon footprints remain lower than the prescribed standards even. The readings noted are compared with the norms set by the Punjab Pollution Control Board. The report on Air Quality Monitoring of the university is prepared for Internal Quality Assurance Cell, GNDU by Dr. Rajinder Kaur Gill, Professor, Botanical and Environmental Sciences Department of the university.

1. INTRODUCTION

Awareness of daily levels of air pollution is very important for people especially that suffer from illnesses caused by air pollution. The concept of air quality index (AQI is widely used for air quality description in many countries. The main objective of an AQI is to quickly disseminate air quality information (almost in real-time). Guru Nanak Dev University is having team of scientists that monitor quality of air in university campus on regular basis by using various sophisticated instruments as discussed in the report.

2. PM 2.5 MONITORING USING AMBIENT AIR QUALITY SAMPLER

In June 2021, PPCB has installed one additional manual ambient air quality monitoring station in the Department of Botanical & Environmental Sciences (figure 1). The sampling of air was done in the university campus (Department of Botanical ad Environmental Sciences) on October 19, 2021 with Respirable Dust Sampler (make Envirotech APM 460 DXNL) using standard methods of Central Pollution Control Board (CPCB Volume I, Guidelines for the Measurements of Ambient Air Pollutants; National Ambient Air Quality Series: NAAQMS/36/2012-13). The value of PM 2.5 on sampling date ranged from 297 to 391.15 ($\mu g/m^3$), 0.97 to 1.35 SO_2 ($\mu g/m^3$) and 5.485 to 8.65 NO_2 ($\mu g/m^3$). Results are given in Table 1. The results revealed higher value of PM 2.5 than the permissible limit of CPCB, while concentration of SO_2 and NO_2 were found much lesser than the max. permissible limits.

Table 1. Concentration of PM 2.5, SO_2 and NO_2 Monitored on Sampling Site.

S. No.	Parameters	Site (Department of Botanical and Environmental Sciences)	Date and Time of Sampling October 19-2020, 2021	Concentration ($\mu g/m^3$)	Max. Permissible limit of NAAQS of CPCB (24 hourly) ($\mu g/m^3$)
1.	PM 2.5 ($\mu g/m^3$)	Night	10:30 PM – 6:30 AM	391.15	60
		Morning	6:45 AM- 2:45 PM	297	
2.	SO_2 ($\mu g/m^3$)	Night	10:30 PM – 6:30 AM	1.35±0.01	80
		Morning	6:45 AM- 2:45 PM	0.97±0.02	
3.	NO_2 ($\mu g/m^3$)	Night	10:30 PM – 6:30 AM	8.65±0.26	80
		Morning	6:45 AM- 2:45 PM	5.485±0.28	

Figure 1: Respirable Dust Sampler for Sampling of PM 2.5, SO_2 and NO_2

3. PORTABLE PM_2 SENSOR-BASED MONITORING:

GNDU in collaboration with the Research Institute of Humanity & Nature (RIHN), Kyoto, Japan in the year 2020 on Stubble burning in North India and its effects on air pollution (figure 2). The monitoring of PM 2.5 based on sensor was found within the permissible limit of NAAQS of CPCB in the month of June –July 2021.

https://www.chikyu.ac.jp/rihn_e/project/2020-01.html

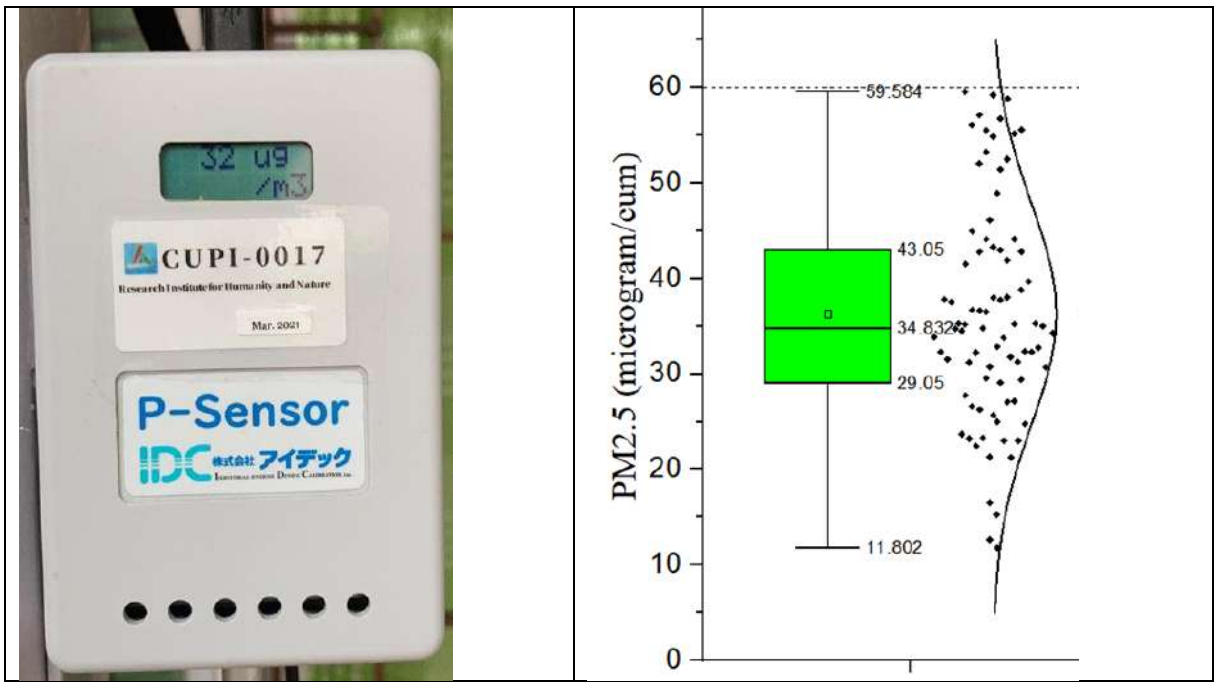


Figure 2: (A) Portable PM 2.5 Sensor (B) Box-plot of PM 2.5 in GNDU during June-July, 2021

4. OZONE MONITORING

Ozone is the second most dangerous parameter as it aggravates lung diseases such as asthma, emphysema, and chronic bronchitis. Monitoring of ozone was done on October 19, 2021 at various sites Figure 3 of Guru Nanak Dev University using portable Ozone Air Monitor

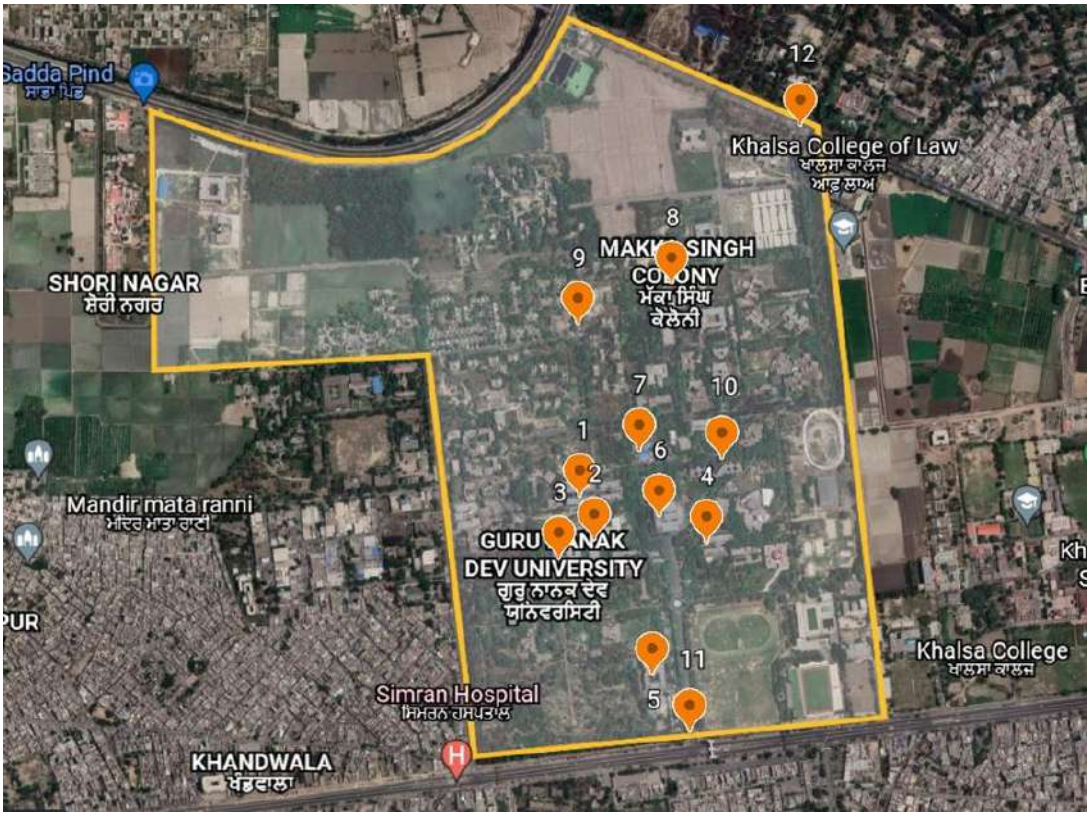


Figure 3: Sampling Sites shown on Map Downloaded from Google Earth

(Make Eltech Engineers Private limited). The average concentration of ozone was observed to be 0-11 ppb which is within the permissible limit of NAAQS of CPCB (table 2; figure 4).

Table 2 Concentration of Ozone, VOC and AQI monitored on various sampling site.

Site No.	Site Name	Ozone Concentration (ppb)	VOC (ppm)	Air Quality Index
1	Department of Botanical and Environmental Sciences	6	0.037	207
2	Department of Computer Science	2	0.7	207
3	Department of Pharmaceutical Science	4	1.6	220
4	Department of Chemistry	2	2.3	229
	Administrative Block	5	0.9	216
5	Bhi Gurdas Library	0	0.4	213
6	Deshmesh Auditorium	4	0.3	201
7	Health Centre	2	0.4	208
8	Residential Area	3	0.9	219
9	Canteen near Arts Block	11	4.4	219
10	**Outside Front Gate (outside GNDU campus)**	**9**	**2.0**	**218**
11	**Outside Back Gate (outside GNDU campus)**	**11**	**7.8**	**219**

Figure 4: Portable Ozone Air Monitor Reading near Health Centre, GNDU, Campus

5. TOTAL VOC MONITORING

Volatile organic compounds (VOCs) are emitted as gases from various solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors examples are paints, solvents, wood preservatives, aerosol sprays, cleansers and disinfectants, air fresheners, office equipment such as copiers and printers, glues and adhesives, permanent markers etc. Health effects of VOC include eye, nose and throat irritation, headaches, loss of coordination and nausea, damage to liver, kidney and central nervous system etc at higher concentration.

Figure 5: Portable VOC Reading in Bhai Gurdas Library, GNDU, Campus

Total VOC content (indoor) was monitored in various departments of the university using Portable VOC Monitor (Make: Honeywell Mini RAE Lite). The total VOC content in the university campus ranged from 0.037 to 7.8 (Table 2, Figure 5).

6. MONITORING OF AIR QUALITY INDEX

Air quality index was recorded at various sites of Guru Nanak Dev University, using Portable Air Quality Monitor (Make Huma-i HI-150 with advanced temperature, humidity, CO_2, Volatile Organic Compounds (VOC), and Particulate Matter ((PM2.5 & PM10) sensors (Figure 6).

Figure 6: Portable Air Quality Monitor Reading of PM 1 and AQI at Bhai Gurdas Library, GNDU, Campus.

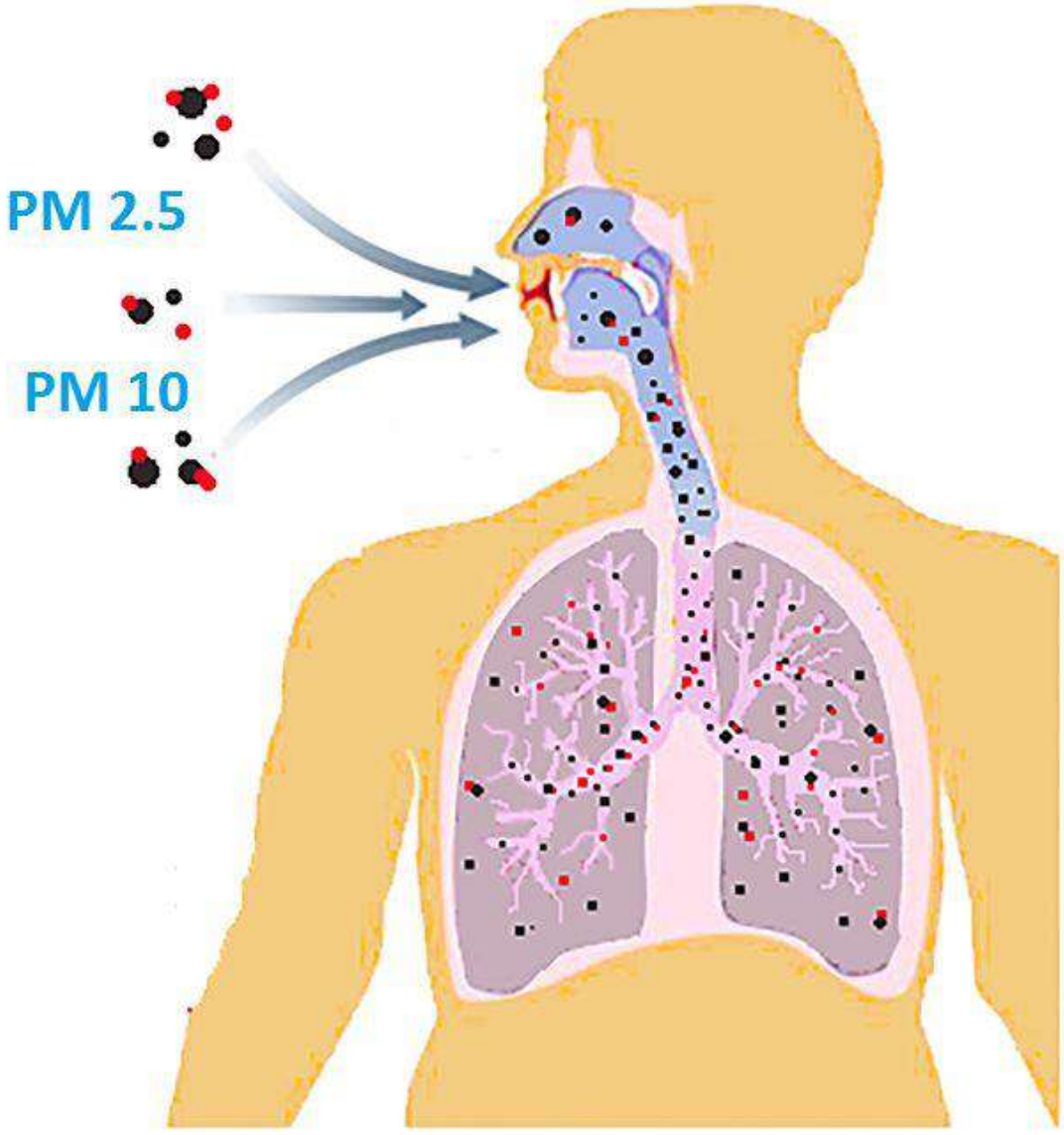
As per CPCB's (Central Pollution Control Board) air quality standards, AQI is categorised into six parts. AQI between 0-50 is considered 'good', 51-100 'satisfactory', 101-200 'moderate', 201-300 'poor', 301-400 'very poor', and between 401-500 'severe'. As the AQI value increases, health impacts become serious. Under satisfactory AQI, sensitive people might witness minor breathing discomfort, while severe AQI may cause respiratory impact even on healthy people, and can serious health issue in people with existing respiratory issues. The AQI in university campus ranged from 201 to 229 which fall under POOR category on sampling date (table 2 and 3).

Table 3: AQI and Possible Health Impacts

Daily AQI Colour	Values of Index	Levels of Health Concern	Description of Air Quality
Green	0-50	Good	Minimal Impact
Yellow	51-100	Satisfactory	Minor breathing discomfort to sensitive people
Orange	101-200	Moderate	Breathing discomfort to the people with lungs, asthma and heart diseases
Red	201-300	Poor	Breathing discomfort to most people on prolonged exposure
Purple	301-400	Very Poor	Respiratory illness on prolonged exposure
Maroon	401-500	401-500 'severe'	Affects healthy people and seriously impacts those with existing diseases

7. CONCLUSION

The air quality of Guru Nanak Dev University campus varies with season. The quality of air of campus is much better than surrounding as compared to Amritsar city due to large plantation cover. Most of the air quality parameters are within the prescribed limits of NAAQS of CPCB.


PM 2.5
PM 10

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Water and Wastewater Management

Guru Nanak Dev University
Amritsar

Preface

Providing portable water to all in the society is one of the important goal of any Government. The individual campuses are the role model in sitting examples regarding sustainable water provision practices. They also act as prime institutes to showcase best use of their wastewater. Guru Nanak Dev University has been practicing water and wastewater management to make itself a zero discharge campus. This report is prepared for Internal Quality Assurance Cell of the University by Dr. Manpreet Singh Bhatti, Professor, Department of Botanical and Environmental Sciences, and Dr. Kiran Sandhu, Associate Professor, Guru Ramdas School of Planning to highlight the salient characteristics of water management; wastewater management and water conservation; and rainwater harvesting practices being followed by the University.

1. BACKGROUND

Water management is one of the key agendas in the light of the United Nations Sustainable Development Goal (*Goal 11 Sustainable Cities & Communities*). The Punjab Water Resources (Regulation and Management) Act of 2020 established the Punjab Water Regulation and Development Authority (PWRDA), which is in charge of regulating and managing the state's water resources in a reasonable, equitable, and long-term manner. As a result, an effort was made at Guru Nanak Dev University in Amritsar to get access to the judicial use of water. In addition, efforts are being made to guarantee that the water supply management system, as well as the reuse of treated wastewater on campus, are working smoothly. Guru Nanak Dev University is committed to follow guidelines for water efficiency management systems-Requirements with guidance for use as per ISO 46001: 2019 (***Annexure-1***).

2. OBJECTIVES AND PRACICES

- System of water supply management in the campus
- Drinking water quality in the campus as per drinking water specifications (IS 10500: 2012)
- Wastewater treatment scheme and its compliance
- Performance evaluation of wastewater treatment plant and reuse potential of treated wastewater
- Water conservation and harvesting practices

3. TOPOGRAPHY AND WEATHER CONDITIONS

The campus terrain is plain as seen from Google Earth Pro **(Figure 1)**. It is developed on rich alluvial soil having bearing capacity. Most than 2/3rd of its land is used for lawns and agriculture. The overall climate is classified as tropical, semi-arid, and hot. The average temperature and precipitation profile along with wind rose is depicted in **Figure 2** and **Figure 3** respectively. Winters are cold with a minimum night temperature of 4℃ and predominant wind directions are west and north-east with a maximum wind velocity of 12 km/hour.

Figure1: Terrain Map of GNDU from Google Earth Pro

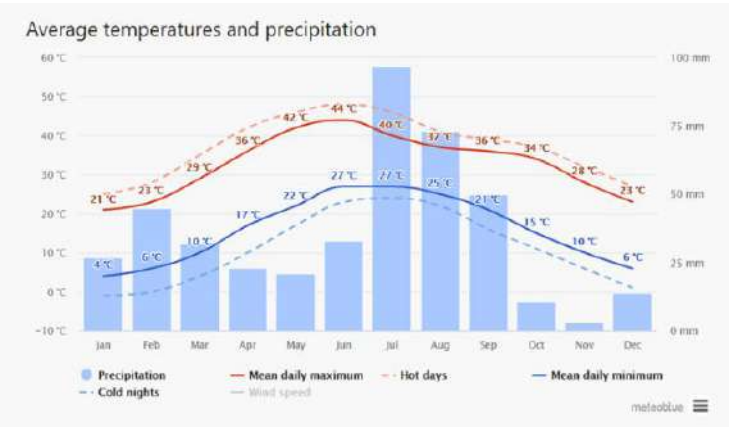

Figure 2: Average Temperature and Precipitation in Amritsar (2019)

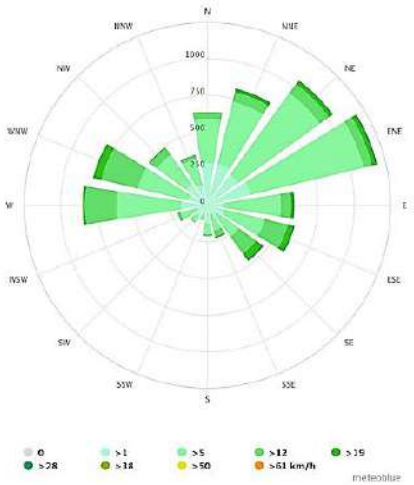

Figure 3 Wind Rose Profile of Amritsar City (2019)

4. WATER MANAGEMENT

Water abstraction and wastewater generation are complementary to each other. As per Manual of Water Supply and Sewerage by Ministry of Urban Development, wastewater generation is about 80% of the water consumption.

4.1 Source of Water Supply

GNDU has its water supply network and water is abstracted using seven tube wells installed at different locations in it. GPS details and locations are given in **Table 1** and **Figure 4**. A total of 2.94 MLD of water is extracted from these tube wells and it meets institutional, residential, agricultural, and landscaping demands of the campus.

Table 1: GPS Coordinates of Borewells

Tube Well Number	Latitude	Longitude	Location
TW-2	31.642680°N	74.823170°E	Near OHR
TW-3	31.640970°N	74.823610°E	Near Water Supply Dept.
TW-4	31.636956°N	74.823569°E	Near Biotechnology
TW-5	31.638278°N	74.827718°E	Inside Boy's Hostel
TW-6	31.635111°N	74.822007°E	Outside Girl's Hostel
TW-7	31.636609°N	74.825375°E	Near Generator House
TW-8	31.641230°N	74.827330°E	Near MYAS

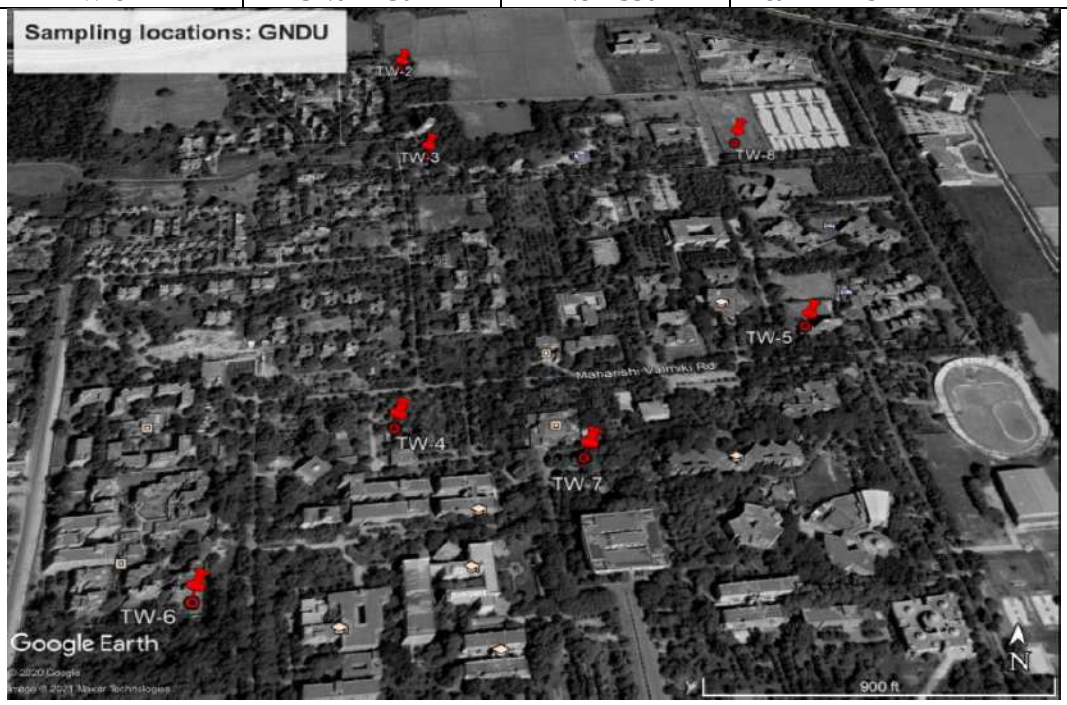

Figure 4: Map of the Borewell Locations

4.2. Water Supply Network

Water supply lines are interconnected with each other. The water supply network in the campus is interconnected with pipes ranging from 14", 12", 10", 8" and 6" in diameter. Based on the total water supplied in the university, per capita water supplied is 185.7 liters per person per day. The water pressure is maintained using a pressure gauge (**Figure 5**) installed in the water cell of the university and about 40-45 psi pressure is maintained during the daytime. During night hours, supply is given through Over Head Reservoir (**Figure 6**) with the capacity of two lakh gallons.

Figure 5: Pressure Gauge

Figure 6: Over Head Reservoir

4.3. Borewell Profile

The typical borewell profile of the tube well in the campus is given in ***Annexure-2.*** The water abstraction is done through different layers tapped (Layer contained coarse sand are used for water abstraction) with a borewell depth of 505 feet.

4.4. Water Quality Analysis

The water quality in the campus is checked periodically through testing of water samples collected from the seven tube wells. The Department of Botanical & Environmental Sciences conducted a water quality analysis for GNDU **(Figure 7)**. For testing, the American Public Health Association's 19th edition of "Standard Methods for the Examination of Water and Wastewater Analysis," released in 1995, was used. During the year 2020, the Department of Botanical and Environmental Sciences collected and analysed the samples. The results of the tests are compared with Indian Drinking Water Specifications as given in IS 10500: 2012 (**Annexure-3**). **Table 2 to Table 8** shows the results of the drinking water quality from different borewells in the campus.

Figure 7: Sampling from Boys Hostel (10.12.2020)

Table -2 Drinking Water Quality of TW-2

Location of Sample/Tube well No : Near Over Head Reservoir / **TW – 2**
Depth of Bore well : 500 feet
Year of Installation : 20-08-2008
Date of sampling : 10-12-2020

S. No.	Parameter	Method	TW-2	BIS Guidelines	
				Acceptable	Permissible
1	Colour (Pt-Co scale) Hazen	Visual comparison	Clear	< 5	< 15
2	Odour	Test cold and when heated	Nil	-	
3	pH	Electrometric	7.5	6.5 - 8.5	-
4	Taste	-	Agreeable	Agreeable	
5	Turbidity	Nephelometric	< 1	<1 NTU	< 5 NTU
6	Total Dissolved Solids	Gravimetric	340	< 500 mg/L	< 2000 mg/L
7	Calcium	EDTA Titrimetric	66	< 75 mg/L	< 200 mg/L
8	Chloride	Argentometric	9	< 250 mg/L	< 1000 mg/L
9	Fluoride	SPANDS	0.42	< 1 mg/L	< 1.5 mg/L
10	Iron (as Fe)	Phenanthroline	0.08	< 0.3 mg/L	-
11	Magnesium	Calculation method	24	< 30 mg/L	< 100 mg/L
12	Nitrate (as NO_3)	UV absorbance, 220 nm	1.5	< 45 mg/L	-
13	Sulfate, mg/L	Gravimetric	8	< 200 mg/L	< 400 mg/L
14	Total Alkalinity (as $CaCO_3$)	Titration method	**300**	< 200 mg/L	< 600 mg/L
15	Total Hardness (as $CaCO_3$)	EDTA Titrimetric	**228**	< 200 mg/L	< 600 mg/L
16	Conductivity (microS/cm)	Conductivity meter	690	-	-

Opinion: Total Hardness and Total Alkalinity exceeds acceptable limit but well below the permissible limit. Sample pass the Indian Standard IS 10500: 2012 test for Drinking Water Quality in terms of the above parameters.

Water Quality: Very Good

Table 3: Drinking Water Quality of TW-3

Location of Sample/Tube well No : Near Water Supply Department / **TW – 3**
Depth of Bore well : 500 feet
Year of Installation : 16-01-2016
Date of sampling : 10-12-2020

S. No.	Parameter	Method	TW-3	BIS Guidelines	
				Acceptable	Permissible
1	Colour (Pt-Co scale) Hazen	Visual comparison	Clear	< 5	< 15
2	Odour	Test cold and when heated	Nil	-	
3	pH	Electrometric	7.5	6.5 - 8.5	-
4	Taste	-	Agreeable	Agreeable	
5	Turbidity	Nephelometric	< 1	<1 NTU	< 5 NTU
6	Total Dissolved Solids	Gravimetric	330	< 500 mg/L	< 2000 mg/L
7	Calcium	EDTA Titrimetric	60	< 75 mg/L	< 200 mg/L
8	Chloride	Argentometric	10	< 250 mg/L	< 1000 mg/L
9	Fluoride	SPANDS	0.31	< 1 mg/L	< 1.5 mg/L
10	Iron (as Fe)	Phenanthroline	0.08	< 0.3 mg/L	-
11	Magnesium	Calculation method	22	< 30 mg/L	< 100 mg/L
12	Nitrate (as NO_3)	UV absorbance, 220 nm	1.5	< 45 mg/L	-
13	Sulfate, mg/L	Gravimetric	10	< 200 mg/L	< 400 mg/L
14	Total Alkalinity (as $CaCO_3$)	Titration method	**240**	< 200 mg/L	< 600 mg/L
15	Total Hardness (as $CaCO_3$)	EDTA Titrimetric	**224**	< 200 mg/L	< 600 mg/L
16	Conductivity (microS/cm)	Conductivity meter	680	-	-

Opinion: Total Hardness and Total Alkalinity exceeds acceptable limit but well below the permissible limit. Sample pass the Indian Standard IS 10500: 2012 test for Drinking Water Quality in terms of above parameters.

Water Quality: Very Good

Table 4: Drinking Water Quality of TW-4

Location of Sample/Tube well No : Near Biotechnology Dept. / **TW – 4**
Depth of Bore well : 500 feet
Year of Installation : 20-11-1995
Date of sampling : 10-12-2020

S. No.	Parameter	Method	TW-4	BIS Guidelines	
				Acceptable	Permissible
1	Colour (Pt-Co scale) Hazen	Visual comparison	Clear	< 5	< 15
2	Odour	Test cold and when heated	Nil	-	
3	pH	Electrometric	7.4	6.5 - 8.5	-
4	Taste	-	Agreeable	Agreeable	
5	Turbidity	Nephelometric	< 1	<1 NTU	< 5 NTU
6	Total Dissolved Solids	Gravimetric	430	< 500 mg/L	< 2000 mg/L
7	Calcium	EDTA Titrimetric	70	< 75 mg/L	< 200 mg/L
8	Chloride	Argentometric	19	< 250 mg/L	< 1000 mg/L
9	Fluoride	SPANDS	0.20	< 1 mg/L	< 1.5 mg/L
10	Iron (as Fe)	Phenanthroline	0.08	< 0.3 mg/L	-
11	Magnesium	Calculation method	26	< 30 mg/L	< 100 mg/L
12	Nitrate (as NO_3)	UV absorbance, 220 nm	1.5	< 45 mg/L	-
13	Sulfate, mg/L	Gravimetric	20	< 200 mg/L	< 400 mg/L
14	Total Alkalinity (as $CaCO_3$)	Titration method	**310**	< 200 mg/L	< 600 mg/L
15	Total Hardness (as $CaCO_3$)	EDTA Titrimetric	**316**	< 200 mg/L	< 600 mg/L
16	Conductivity (microS/cm)	Conductivity meter	880	-	-

Opinion: Total Hardness and Total Alkalinity exceeds acceptable limit but well below the permissible limit. Sample pass the Indian Standard IS 10500: 2012 test for Drinking Water Quality in terms of the above parameters.

Water Quality: Good

Table 5: Drinking Water Quality of TW-5

Location of Sample/Tube well No : Inside Boy's Hostel / **TW – 5**
Depth of Bore well : 500 feet
Year of Installation : 14-02-2017
Date of sampling : 10-12-2020

S. No.	Parameter	Method	TW-2	BIS Guidelines	
				Acceptable	Permissible
1	Colour (Pt-Co scale) Hazen	Visual comparison	Clear	< 5	< 15
2	Odour	Test cold and when heated	Nil	-	
3	pH	Electrometric	7.4	6.5 - 8.5	-
4	Taste	-	Agreeable	Agreeable	
5	Turbidity	Nephelometric	< 1	<1 NTU	< 5 NTU
6	Total Dissolved Solids	Gravimetric	320	< 500 mg/L	< 2000 mg/L
7	Calcium	EDTA Titrimetric	56	< 75 mg/L	< 200 mg/L
8	Chloride	Argentometric	8	< 250 mg/L	< 1000 mg/L
9	Fluoride	SPANDS	0.15	< 1 mg/L	< 1.5 mg/L
10	Iron (as Fe)	Phenanthroline	0.05	< 0.3 mg/L	-
11	Magnesium	Calculation method	20	< 30 mg/L	< 100 mg/L
12	Nitrate (as NO_3)	UV absorbance, 220 nm	1.5	< 45 mg/L	-
13	Sulfate, mg/L	Gravimetric	9	< 200 mg/L	< 400 mg/L
14	Total Alkalinity (as $CaCO_3$)	Titration method	**250**	< 200 mg/L	< 600 mg/L
15	Total Hardness (as $CaCO_3$)	EDTA Titrimetric	**224**	< 200 mg/L	< 600 mg/L
16	Conductivity (microS/cm)	Conductivity meter	660	-	-

Opinion: Total Hardness and Total Alkalinity exceeds acceptable limit but well below the permissible limit. Sample pass the Indian Standard IS 10500: 2012 test for Drinking Water Quality in terms of above parameters.

Water Quality: Very Good

Table 6: Drinking Water Quality of TW-6

Location of Sample/Tube well No : Outside Girl's Hostel / **TW – 6**
Depth of Bore well : 300 feet
Year of Installation : 06-12-2011
Date of sampling : 10-12-2020

S. No.	Parameter	Method	TW-6	BIS Guidelines	
				Acceptable	Permissible
1	Colour (Pt-Co scale) Hazen	Visual comparison	Clear	< 5	< 15
2	Odour	Test cold and when heated	Nil	-	
3	pH	Electrometric	7.4	6.5 - 8.5	-
4	Taste	-	Agreeable	Agreeable	
5	Turbidity	Nephelometric	< 1	<1 NTU	< 5 NTU
6	Total Dissolved Solids	Gravimetric	460	< 500 mg/L	< 2000 mg/L
7	Calcium	EDTA Titrimetric	**79**	< 75 mg/L	< 200 mg/L
8	Chloride	Argentometric	41	< 250 mg/L	< 1000 mg/L
9	Fluoride	SPANDS	0.49	< 1 mg/L	< 1.5 mg/L
10	Iron (as Fe)	Phenanthroline	0.05	< 0.3 mg/L	-
11	Magnesium	Calculation method	29	< 30 mg/L	< 100 mg/L
12	Nitrate (as NO_3)	UV absorbance, 220 nm	1.5	< 45 mg/L	-
13	Sulfate, mg/L	Gravimetric	24	< 200 mg/L	< 400 mg/L
14	Total Alkalinity (as $CaCO_3$)	Titration method	**310**	< 200 mg/L	< 600 mg/L
15	Total Hardness (as $CaCO_3$)	EDTA Titrimetric	**356**	< 200 mg/L	< 600 mg/L
16	Conductivity (microS/cm)	Conductivity meter	960	-	-

Opinion: Total Hardness and Total Alkalinity exceeds acceptable limit but well below the permissible limit. Sample pass the Indian Standard IS 10500: 2012 test for Drinking Water Quality in terms of above parameters.

Water Quality: Good

Table 7: Drinking Water Quality of TW-7

Location of Sample/Tube well No : Near Generator House / **TW – 7**
Depth of Bore well : 300 feet
Year of Installation : 08-08-2020
Date of sampling : 10-12-2020

S. No.	Parameter	Method	TW-7	BIS Guidelines	
				Acceptable	Permissible
1	Colour (Pt-Co scale) Hazen	Visual comparison	Clear	< 5	< 15
2	Odour	Test cold and when heated	Nil	-	
3	pH	Electrometric	7.4	6.5 - 8.5	-
4	Taste	-	Agreeable	Agreeable	
5	Turbidity	Nephelometric	< 1	<1 NTU	< 5 NTU
6	Total Dissolved Solids	Gravimetric	440	< 500 mg/L	< 2000 mg/L
7	Calcium	EDTA Titrimetric	64	< 75 mg/L	< 200 mg/L
8	Chloride	Argentometric	19	< 250 mg/L	< 1000 mg/L
9	Fluoride	SPANDS	0.32	< 1 mg/L	< 1.5 mg/L
10	Iron (as Fe)	Phenanthroline	0.10	< 0.3 mg/L	-
11	Magnesium	Calculation method	24	< 30 mg/L	< 100 mg/L
12	Nitrate (as NO_3)	UV absorbance, 220 nm	1.2	< 45 mg/L	-
13	Sulfate, mg/L	Gravimetric	24	< 200 mg/L	< 400 mg/L
14	Total Alkalinity (as $CaCO_3$)	Titration method	**320**	< 200 mg/L	< 600 mg/L
15	Total Hardness (as $CaCO_3$)	EDTA Titrimetric	**292**	< 200 mg/L	< 600 mg/L
16	Conductivity (microS/cm)	Conductivity meter	920	-	-

Opinion: Total Hardness and Total Alkalinity exceeds acceptable limit but well below the permissible limit. Sample pass the Indian Standard IS 10500: 2012 test for Drinking Water Quality in terms of above parameters.

Water Quality: Good

Table 8: Drinking Water Quality of TW-8

Location of Sample/Tube well No : Near MYAS / **TW – 8**
Depth of Bore well : 300 feet
Year of Installation : 12-12-2017
Date of sampling : 10-12-2020

S. No.	Parameter	Method	TW-8	BIS Guidelines	
				Acceptable	Permissible
1	Colour (Pt-Co scale) Hazen	Visual comparison	Clear	< 5	< 15
2	Odour	Test cold and when heated	Nil	-	
3	pH	Electrometric	7.5	6.5 - 8.5	-
4	Taste	-	Agreeable	Agreeable	
5	Turbidity	Nephelometric	< 1	<1 NTU	< 5 NTU
6	Total Dissolved Solids	Gravimetric	330	< 500 mg/L	< 2000 mg/L
7	Calcium	EDTA Titrimetric	56	< 75 mg/L	< 200 mg/L
8	Chloride	Argentometric	9	< 250 mg/L	< 1000 mg/L
9	Fluoride	SPANDS	0.18	< 1 mg/L	< 1.5 mg/L
10	Iron (as Fe)	Phenanthroline	0.05	< 0.3 mg/L	-
11	Magnesium	Calculation method	20	< 30 mg/L	< 100 mg/L
12	Nitrate (as NO_3)	UV absorbance, 220 nm	2.0	< 45 mg/L	-
13	Sulfate, mg/L	Gravimetric	10	< 200 mg/L	< 400 mg/L
14	Total Alkalinity (as $CaCO_3$)	Titration method	**250**	< 200 mg/L	< 600 mg/L
15	Total Hardness (as $CaCO_3$)	EDTA Titrimetric	**228**	< 200 mg/L	< 600 mg/L
16	Conductivity (microS/cm)	Conductivity meter	680	-	-

Opinion: Total Hardness and Total Alkalinity exceeds acceptable limit but well below the permissible limit. Sample pass the Indian Standard IS 10500: 2012 test for Drinking Water Quality in terms of the above parameters.

Water Quality: Very Good

TDS levels in all tube wells are less than 500 mg/L, which is well within the permissible range for drinking water. Except for TW-6, when both hardness and alkalinity levels surpass 300 mg/L, both hardness and alkalinity values are in the range of 220-320 mg/L. This could be a variety of subsurface strata. TW-6 also extracts water up to 300 feet, according to verbal discussions with water supply department personnel.

4.5. Water Saving Potential

Table 9 shows the current situation of water abstraction as reported by the GNDU Water Cell. The entire power use (estimate) is around 831 KWh, which equates to Rs 5849 per day at Rs 7 per kWh electricity rates. As a result, the annual water bill is Rs 21 lakhs. If you take conservation measures (say, a 20% reduction in water consumption), you can save Rs 4 lakh per year. In addition, this cost-cutting will save 21 crore litres of water every year.

Table 9: Details of Tube Wells along with Motor Horsepower and Energy Consumption

Tube Well No	Pipe Dia (inches)	Horse Power	Power (KWh)	Working Hours	Total KWh	Flow Rate (LPM)	Total Flow (KL/day)
TW-2	6”	50	37.3	3	112	2150	387
TW-3	6”	50	37.3	3	112	2150	387
TW-4	6”	50	37.3	6	224	2150	774
TW-5	6”	50	37.3	6	224	2150	774
TW-6	4”	30	22.4	2	45	1500	180
TW-7	4”	30	22.4	2	45	1500	180
TW-8	6”	50	37.3	2	75	2150	258
			231	24	836	13750	2940

The total water abstraction is calculated to be about 2940 KL/day on a working day. This translates to 245 Litre per capita demand (LPCD) by taking a campus population of 12000. This is on the higher side (135 LPCD is as per government norms) but it includes water consumption in construction activity, horticulture, etc. Although, the wastewater treatment plant showed a wastewater consumption of 1800 KL/day (80% of the freshwater demand). This gap may be due to wrong calculation in pumping efficiency or working hours.

5. WASTEWATER MANAGEMENT

In the year 2008, GNDU installed a low-cost wastewater treatment plant with a maximum capacity of 2500 KL/day at a cost of approximately 38 lakhs.

5.1. Treatment Scheme

Bar Screen→ Aeration Tank→Tube Settler → Oxidation Pond (1st Stage)→ Oxidation Pond (2nd Stage)→ Reuse of Treated Wastewater in Agriculture and Social Forestry.

The satellite view and line diagram are given in **Figure 8** and **Figure 9** respectively.

Figure 8: Satellite View of STP

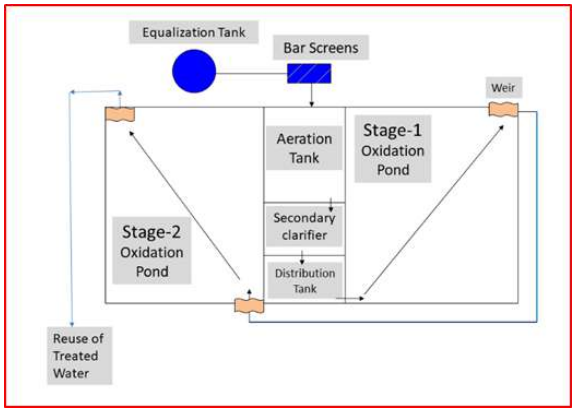

Figure 9: Layout of STP

Dimensions of different unit operations and processes are given in **Table 10**. The volume of sewage treated is ~1800 KL/day as per V-notch (**Figure 10**) and ultrasonic flow meter (**Figure 11**) installed at Sewage Treatment Plant. The treated wastewater has a mode of disposal on to land for plantation and social forestry. The validity of the consent as per the Water (Prevention & Control) Act, 1974 is up to 07-02-2023 (***Annexure-4***).

Table 10. Dimensions of Different Unit Operations and Processes

Unit Processor	Dimensions (m)
Aeration Tank	10 m x 5 m x 3 m SWD
Secondary Clarifier (Tube Settler)	5 m x 5 m x 60° tube settler
Oxidation Pond (1st Stage)	120 m x 60 m x 1.2 SWD
Oxidation Pond (2nd Stage)	120 m x 60 m x 1.2 SWD

Figure 10: V-notch for Flow Measurement

Figure 11: Ultrasonic Flow Meter at STP

5.2. Treated Wastewater Quality

Treated wastewater quality is well within the discharge standards prescribed by Punjab Pollution Control Board. The self-monitoring report is attached for reference (**Table 11**). Treated wastewater was clear and no visible suspended solids. Also, BOD (calculation-based) value is well within the limit of 30 mg/L. Overall, samples pass the prescribed guidelines and are well within pollution control board norms.

Table 11: Wastewater Analysis of Untreated and Treated Wastewater

Source of sample : **Sewage Treatment Plant, GNDU**

Date of sampling : 15-02-2021 at 3.45 PM

No. of Samples taken : **2 (Inlet & Outlet)**

Parameter	**Method**	**Untreated Wastewater**	**Treated Wastewater**	**Discharge Standards by PPCB**
	Location→	V-notch	Outlet weir of oxidation pond (2nd stage)	
pH	pH meter	8.3 ± 0.1	8.4 ± 0.1	6.5-9.5
Colour	Visual	Yellowish	Clear	Clear
Total Dissolved Solids	Gravimetric method	520	490	2100 mg/L
Total Suspended Solids	Gravimetric method	150	10	100 mg/L
Chemical Oxidation Demand	Closed reflux method	60	24	250 mg/L
Biochemical Oxygen Demand	Calculation method*	40	8	30 mg/L
Ammonia as NH^{3-}	Ion-selective electrode	13	9.2	50 mg/L

* COD/BOD ratio=1.5 (Inlet), 3 (Treated)

5.3. Suitability of Treated Wastewater for Irrigation Purposes

Treated wastewater was analysed for sodium, calcium, and magnesium content using Flame Photometer (Make: *Systronics*). Calibration curves were prepared for all three ions and samples were injected to get concentration within the input standards. Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the (Ca + Mg) concentration. Sodium Absorption Ratio (SAR) is calculated as per formula was found to be 2.7 (**Table 12**), well below the limit of 10 as per IS 11624: 1986. Overall, the treated wastewater is fit for irrigation.

Table 12: Suitability of Treated Wastewater for Irrigation as per IS 11624: 1986

Source of sample : **Sewage Treatment Plant, GNDU**

Date of sampling : 15-02-2021 at 3.45 PM

No. of Samples taken : **2 (Inlet & Outlet)**

Parameter	Method	Untreated Wastewater	Treated Wastewater
Sodium (mg/L)	Flame Photometer	94	95
Calcium (mg/L)	EDTA Titration	58	56
Magnesium (mg/L)	Calculation method	21	22
Sodium Absorption Ratio (SAR)		2.68	2.71

5.4. Reuse of Treated Wastewater

Treated wastewater is being pumped using 15 Hp motors (2 no's) to increase the head so that treated wastewater can be transported to any part of the university for social forestry and irrigation to plants. The pumping station is shown in **Figure 12**. Also, water tankers (**Figure 13**) are used during the summer months. Any excess wastewater will be used in the artificially constructed water tank whenever required.

Figure 12: Filling Point for Reuse

Figure 13: Tanker for Treated Wastewater Reuse

6. WATER CONSERVATION AND HARVESTING PRACTICES

The university has a vast rainwater conservation and harvesting potentials as there is high annual rainfall accounting for 201mm and 191 mm in the month of July and August. To assess the rainwater potential in the campus, detailed estimation has been done based on three types of surfaces i.e. **paved areas** consisting of roads, parkings and footpaths; **buildings;** and **unpaved areas** comprising of lawns and other dense or little vegetation areas. Based on the rainfall, different types of surface areas and respective runoff coefficient, total potential rainwater harvesting has been calculated as 2,26,348 kilo liters of water per year.

- All the unpaved lawns within or surrounding the administrative, academic and residential buildings act as open recharge wells in the campus. Kerbs along the roads of the campus act as retaining walls around the lawns and parks, which restrict the rainwater runoff out of them. Hence, the rainwater collected in these lawns goes down the unpaved surface through seepage **(Figure 14)** and betters the water level of the campus and the city.

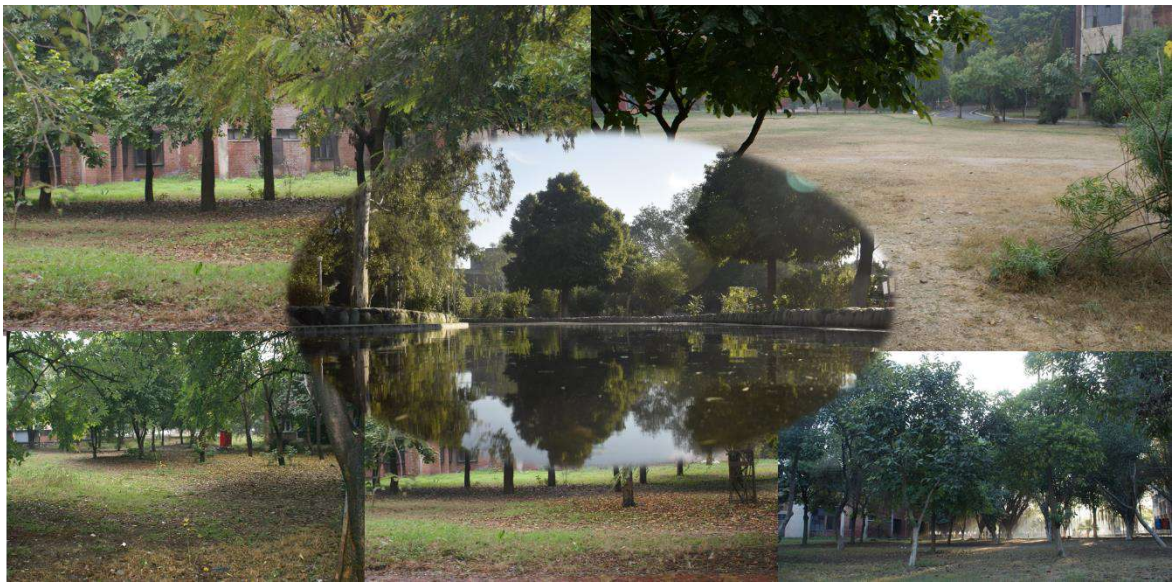

Figure 14: Unpaved Lawns as Rainwater Recharge Wells

- Majority of the buildings of the campus are designed to have open well structures. The rooftop rainwater of these buildings is routed to these unpaved areas of the wells, which recharges the underground water through seepage **(Figure 15).**

Figure 15: Unpaved Wells of the Buildings as Recharge Points

- The footpaths have been constructed in the university to facilitate the pedestrians but due care is given to their contribution to rainwater harvesting as well. Inter-locking tiles are used in their construction, which allow the rainwater to seep into the unpaved ground. Also, the slope of the footpaths is inclined either way so that the rainwater gets drained onto the unpaved surface on their either side (**Figure 16)**.

Figure 16: Rainwater Harvesting Promoting Footpaths

- The Botanical Garden of the university is spread in 100000 square meters area, which has the potential to harvest 17 kiloliters of rainwater harvesting per year. The unpaved lawns and a small lake within the garden act as huge rainwater recharge wells **(Figure 17)**.

Figure 17: Lawns and Lake of Botanical Garden

- Though the parking lots of the university are paved but the slope of the surface is so kept that the rainwater routes to the lawns of the campus. Special provisions have been made at the newly constructed parking lots on either of the entry gates to the university.

Figure 18: Rainwater Harvesting system in the Parking Lot

- The university has renovated the washrooms and toilets of boys and girls hostels, administrative buildings and some of the academic blocks. With an aim to conserve water, timer based and sensor based urinals and water taps are installed **(Figure 19)**. In some academic blocks dry urinals have also been installed. Water closets in the toilet are fitted with dual mode system to save and conserve the water.

Figure 19: Water Saving Washrooms and Toilets

- The university harvests the storm water through two tanks, one in the botanical garden and second in the western side of the university. The surface runoff the roads is channelized through a well-designed drainage network of the university. The storm water is channelized to a tank in the western side of the university for harvesting.

Thus, the initiatives of natural recharge wells, reuse of wastewater for landscaping, water conservation through water efficient fixtures and appliances in toilets and bathrooms and minimising the leakage through effective complaint redressal are a few initiatives that make the campus water sensitive.

7. SWOC ANALYSIS

Strengths	***Weakness***
• Drinking water quality is good as per IS 10500: 2012. • State of the art sewage treatment plant. • Reuse of treated wastewater in the campus. • Rainwater recharge and harvesting.	• Poor pressure in high rise buildings during power failure
Opportunities	***Concerns***
• Real-time water audit using IoT • Application of advanced water conservation technologies	• Depleting ground and abstraction of water from the sixth water table (beyond 500 feet).

8. RECOMMENDATIONS

- Installing a flow meter at each borewell to measure the water abstraction on a monthly basis.
- To maximise the rainwater harvesting capacity, an automatic rainfall sensor may be installed and used to build the rainwater harvesting structures.
- Installing ground water level sensors in a few locations in the campus to check the depleting water table.
- A real-time ultrasonic flow metre may be installed at the treated wastewater pumping station to check the reuse potential.
- Level sensors will be used to synchronise the pumping operations of the equalisation tank and the final effluent.
- Installing water metres in buildings and residences to monitor excessive water consumption.
- Water audit cell may be formed with members from engineering department, civil engineering and electronics technology to streamline water management in the university.
- Establishing flow monitoring and IoT based lab scale experiments in the Civil/Electronics engineering department.
- Adopting decentralized wastewater treatment mechanism to treat the grey, hazardous and black water.
- Installation of water conserving fittings in the remaining administrative, academic and residential buildings.
- Creation of separate budget head for liquid waste management in the campus.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 224, *Service activities relating to drinking water supply, wastewater and stormwater systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Water is essential to life and forms part of the environment. Global concern for the state of the environment has identified that water resources are subject to significant pressures from water demand and from the impacts of climate change. The pressures on organizations to implement water efficiency programmes can arise from limited water resources and exist particularly in resource exploitation activities such as mining, forestry, oil and gas extraction, and in agriculture. They might also arise from commercial, institutional and industrial activities whether water is supplied by water utilities or comes directly from the environment.

As pressure grows to improve the quality of the environment and increase sustainability, organizations of all types and sizes are increasingly turning their attention to the environmental impacts of their activities, products and services. This might include measuring the water footprint of an activity or striving towards a more efficient use of water within an organization. Achieving sound water efficiency performance requires organizational commitment to a systematic approach and to the achievement of continual improvement in water use through a water efficiency management system.

Water efficiency management, like quality management, environmental management and energy management could be a matter of vital interest in promoting sustainable economic activities, industries and ultimately a sustainable environment. The introduction of water efficiency programs is often, but not always, triggered by a shortage in water supply.

The purpose of this document is to enable organizations to assess and account for their water use, and to identify, plan and implement measures to achieve water savings through the systematic management of water. Successful implementation depends on commitment from all levels and functions within the organization, especially commitment by top management.

This document specifies water efficiency management system requirements and contains guidance for its use. Using this document, an organization can develop and implement a water efficiency policy through the establishment of objectives, targets, action plans, monitoring, benchmarking, and review programs. These should take into account any requirements related to significant water use. A water efficiency management system enables an organization to achieve its relevant policy commitments and take action as needed to improve its water management according to the requirements of this document. This document can apply to some or all of the activities under the control of the organization. Application of this document may be tailored to fit the specific requirements of the organization, including the complexity of its system, the degree of documentation and available resources.

In any organization, water might be used for a variety of purposes, including the following:

a) cleaning;

b) transportation;

c) heating and cooling;

d) manufacturing a product and as part of a product;

e) drinking;

f) sanitation;

g) irrigation;

h) fire suppression;

i) recreational, water sport and aesthetic purposes.

The adoption and proper implementation of a water efficiency management system is intended to result in improved water efficiency and can help to achieve the following outcomes:

1) identifying water as a resource that can be considered as part of organizational and budgetary planning;

2) assisting an organization to better manage water use and optimize water demand;

3) recognizing the impact on others that can occur with changing water use;

4) ensuring a greater level of accountability in water use;

5) providing a process for regular review for possible improvement and adoption of opportunities arising in water efficiency.

Water efficiency management systems — Requirements with guidance for use

1 Scope

This document specifies requirements and contains guidance for its use in establishing, implementing and maintaining a water efficiency management system. It is applicable to organizations of all types and sizes that use water. It is focused on end-use consumers.

This document is applicable to any organization that wishes to:

a) achieve the efficient use of water through the 'reduce, replace or reuse' approach;

b) establish, implement and maintain water efficiency;

c) continually improve water efficiency.

This document specifies requirements and contains guidance for its use regarding organizational water use. It includes monitoring, measurement, documentation, reporting, design and procurement practices for equipment, systems, processes and personnel training that contribute to water efficiency management.

NOTE 1 'Reduce' includes the use of water-efficient fittings and equipment and, for example, putting in place a proper monitoring system for usage and leak detection.

NOTE 2 'Replace' includes substitution of drinking water with reclaimed water, sea water and rainwater wherever feasible.

NOTE 3 'Reuse' includes recycling of, for example, process water or grey water. For utilizing water reuse systems, ISO/TC 282 documents can be referred to as guidelines.

NOTE 4 Guidance in the annexes provides additional practical information to support implementation. Annex A provides guidance on the use of this document and Annex B gives examples of scenarios in water efficiency.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 24513, *Service activities relating to drinking water supply, wastewater and stormwater systems — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 24513 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
audit
systematic, independent and documented *process* (3.24) for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled

Note 1 to entry: An audit can be an internal audit (first party) or an external audit (second party or third party), and it can be a combined audit (combining two or more disciplines).

Note 2 to entry: An internal audit is conducted by the organization itself, or by an external party on its behalf.

Note 3 to entry: "Audit evidence" and "audit criteria" are defined in ISO 19011.

[SOURCE: ISO/IEC Directives Part 1, 2019, Annex L, Appendix 2, 3.17]

3.2
baseline water efficiency indicator
reference level of water used per *business activity indicator* (3.4)

Note 1 to entry: "Used" in the context of this indicator means the net amount of water used (including any water consumed) in the course of the *business activity* (3.3), discounting the amount of water applied that is reclaimed or recycled for further use.

Note 2 to entry: The indicator can be established in the initial *water use review* (3.40) considering a data period suitable to the *organization's* (3.20) *water use* (3.39) (including any water consumed).

3.3
business activity
umbrella term covering all the functions, *processes* (3.24), activities and transactions of an *organization* (3.20) and its employees

Note 1 to entry: Includes public administration as well as commercial business.

[SOURCE: ISO 16175-2:2011, 3.4, modified — "an" deleted; 2nd sentence becomes Note 1 to entry.]

3.4
business activity indicator
measure of *business activity* (3.3) that takes into account core business operations specific to the application site

Note 1 to entry: Depending on the business activity indicator, *water use* (3.39) (including any water consumed) will vary. For example, m^3 of water/kg of product; l/person supplied; m^3 of water/guestroom.

EXAMPLE Quantity of products produced, number of staff and visitors, number of guestrooms.

3.5
competence
ability to apply knowledge and skills to achieve intended results

[SOURCE: ISO/IEC Directives Part 1, 2019, Annex L, Appendix 2, 3.10]

3.6
conformity
fulfilment of a *requirement* (3.26)

Note 1 to entry: In English the word "conformance" is synonymous but deprecated. In French the word "compliance" is synonymous but deprecated.

[SOURCE: ISO/IEC Directives Part 1, 2019, Annex L, Appendix 2, 3.18, modified — Note 1 to entry added.]

3.7
continual improvement
recurring activity to enhance *performance* (3.22)

Note 1 to entry: The process of establishing *objectives* (3.19) and finding opportunities for improvement is a continual process through the use of audit findings and audit conclusions, analysis of data, management reviews or other means, and generally leads to *corrective action* (3.8) or preventive action.

Note 2 to entry: In the case of this document the recurring process is one of enhancing the *water efficiency management system* (3.36) in order to achieve improvements in overall *water efficiency performance* (3.37) consistent with the *organization's* (3.20) *water efficiency policy* (3.35).

[SOURCE: ISO/IEC Directives Part 1, 2019, Annex L, Appendix 2, 3.21, modified — Notes 1 and 2 to entry added.]

3.8
corrective action
action to eliminate the cause of a *nonconformity* (3.18) and to prevent recurrence

Note 1 to entry: There can be more than one cause for a nonconformity.

[SOURCE: ISO/IEC Directives Part 1, 2019, Annex L, Appendix 2, 3.20, modified — Note 1 to entry added.]

3.9
documented information
information required to be controlled and maintained by an *organization* (3.20) and the medium on which it is contained

Note 1 to entry: Documented information can be in any format and media, and from any source.

Note 2 to entry: Documented information can refer to:

— the *management system* (3.15), including related *processes* (3.24);

— information created in order for the organization to operate (documentation);

— evidence of results achieved (records).

[SOURCE: ISO/IEC Directives Part 1, 2019, Annex L, Appendix 2, 3.11]

3.10
effectiveness
extent to which planned activities are realized and planned results achieved

[SOURCE: ISO/IEC Directives Part 1, 2019, Annex L, Appendix 2, 3.6]

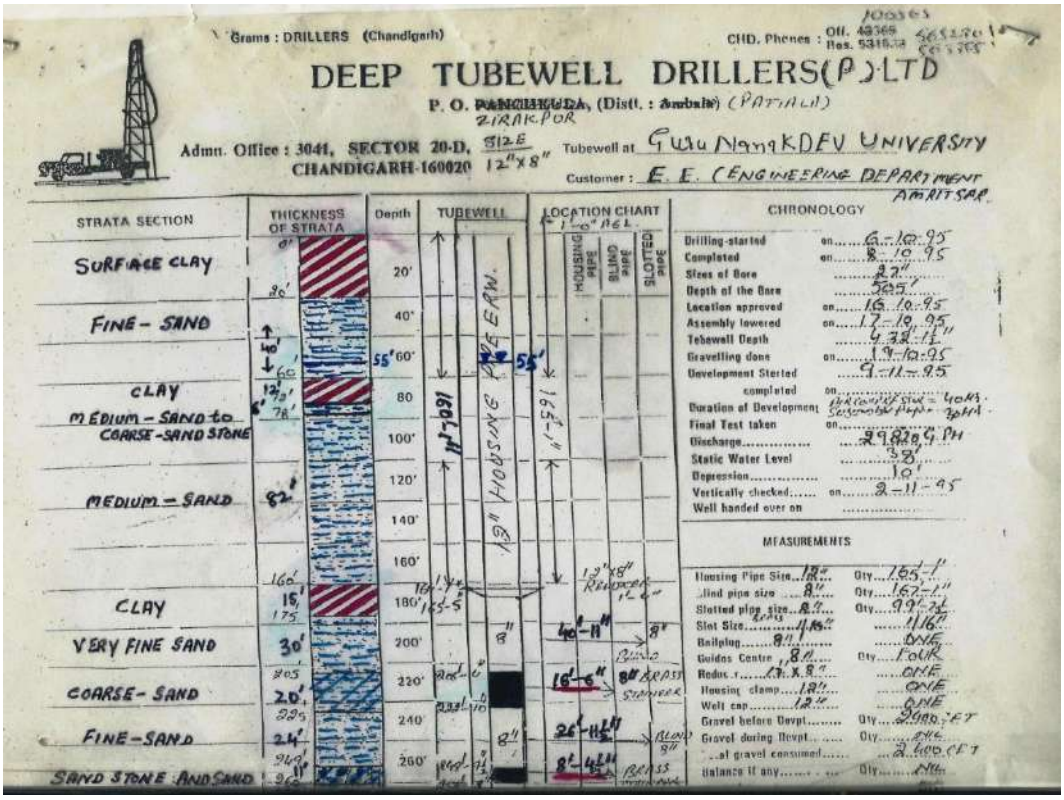
3.11
full-time equivalent
ratio of the total number of occupant hours spent in the facility divided by the standard working hours per day

Note 1 to entry: The ratio provides an estimation of actual facility occupancy in terms of hours occupied per day and is used to determine the number of occupants for the facility.

[SOURCE: ISO 24513:2019, 3.1.15]

3.12
grey water
greywater
graywater
wastewater from bathtubs and showers, hand basins, kitchen sinks, clothes washing and laundry tubs but excluding excreta and *trade effluent* (3.30)

Note 1 to entry: It excludes used water from urinals or toilet bowls.



Borewell profile

भारतीय मानक

पीने का पानी — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

DRINKING WATER — SPECIFICATION

(Second Revision)

ICS 13.060.20

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 2012 **Price Group 6**

AMENDMENT NO. 1 JUNE 2015
TO
IS 10500 : 2012 DRINKING WATER — SPECIFICATION

(Second Revision)

[*Page* 2, *Table* 2, *Sl No.* xii), *col* 3] — Substitute '1.0' *for* '0.3'.

[*Page* 3, *Table* 3, *Sl No.* x) , *col* 4] — Substitute 'No relaxation' *for* '0.05'.

(FAD 14)

Publication Unit, BIS, New Delhi, India

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Drinking Water Sectional Committee had been approved by the Food and Agriculture Division Council.

This standard was originally published in 1983. A report prepared by the World Health Organization in cooperation with the World Bank showed that in 1975, some 1 230 million people were without safe water supplies. These appalling facts were central to the United Nations decision to declare an International Drinking Water Supply and Sanitation decade, beginning in 1981. Further, the VI Five-Year Plan of India had made a special provision for availability of safe drinking water for the masses. Therefore, the standard was formulated with the objective of assessing the quality of water resources, and to check the effectiveness of water treatment and supply by the concerned authorities.

The first revision was undertaken to take into account the up-to-date information available about the nature and effect of various contaminants as also the new techniques for identifying and determining their concentration. Based on experience gained additional requirements for alkalinity; aluminium and boron were incorporated and the permissible limits for dissolved solids, nitrate and pesticides residues modified.

As per the eleventh five year plan document of India (2007-12), there are about 2.17 lakh quality affected habitations in the country with more than half affected with excess iron, followed by fluoride, salinity, nitrate and arsenic in that order. Further, approximately, 10 million cases of diarrhoea, more than 7.2 lakh typhoid cases and 1.5 lakh viral hepatitis cases occur every year a majority of which are contributed by unclean water supply and poor sanitation. The eleventh five year plan document of India (2007-2012) recognizes dealing with the issue of water quality as a major challenge and aims at addressing water quality problems in all quality affected habitations with emphasis on community participation and awareness campaigns as well as on top most priority to water quality surveillance and monitoring by setting up of water quality testing laboratories strengthened with qualified manpower, equipments and chemicals.

The second revision was undertaken to upgrade the requirements of the standard and align with the internationally available specifications on drinking water. In this revision assistance has been derived from the following:

a) EU Directives relating to the quality of water intended for human consumption (80/778/EEC) and Council Directive 98/83/EC.

b) USEPA standard — National Primary Drinking Water Standard. EPA 816-F-02-013 dated July, 2002.

c) WHO Guidelines for Drinking Water Quality. 3rd Edition Vol. 1 Recommendations, 2008.

d) Manual on Water Supply and Treatment, third edition — revised and updated May 1999, Ministry of Urban Development, New Delhi.

This standard specifies the acceptable limits and the permissible limits in the absence of alternate source. It is recommended that the acceptable limit is to be implemented as values in excess of those mentioned under 'Acceptable' render the water not suitable. Such a value may, however, be tolerated in the absence of an alternative source. However, if the value exceeds the limits indicated under 'permissible limit in the absence of alternate source' in col 4 of Tables 1 to 4, the sources will have to be rejected.

Pesticide residues limits and test methods given in Table 5 are based on consumption pattern, persistence and available manufacturing data. The limits have been specified based on WHO guidelines, wherever available. In cases where WHO guidelines are not available, the standards available from other countries have been examined and incorporated, taking in view the Indian conditions.

In this revision, additional requirements for ammonia, chloramines, barium, molybdenum, silver, sulphide, nickel, polychlorinated biphenyls and trihalomethanes have been incorporated while the requirements for colour, turbidity, total hardness, free residual chlorine, iron, magnesium, mineral oil, boron, cadmium, total arsenic, lead, polynuclear aromatic hydrocarbons, pesticides and bacteriological requirements have been modified.

In this revision, requirement and test method for virological examination have been included. Further, requirements and test methods for cryptosporidium and giardia have also been specified.

Routine surveillance of drinking water supplies should be carried out by the relevant authorities to understand the risk of specific pathogens and to define proper control procedures. The WHO Guidelines for Drinking Water Quality, 3rd Edition, Vol. 1 may be referred for specific recommendations on using a water safety approach incorporating risk identification. Precautions/Care should be taken to prevent contamination of drinking water from chlorine resistant parasites such as cryptosporidium species and giardia.

Indian Standard

DRINKING WATER — SPECIFICATION

(Second Revision)

1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for drinking water.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard the following definition shall apply.

3.1 Drinking Water — Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption.

4 REQUIREMENTS

Drinking water shall comply with the requirements given in Tables 1 to 4. The analysis of pesticide residues given in Table 3 shall be conducted by a recognized laboratory using internationally established test method meeting the residue limits as given in Table 5.

Drinking water shall also comply with bacteriological requirements (*see* **4.1**), virological requirements (*see* **4.2**) and biological requirements (*see* **4.3**).

4.1 Bacteriological Requirements

4.1.1 *Water in Distribution System*

Ideally, all samples taken from the distribution system including consumers' premises, should be free from coliform organisms and the following bacteriological quality of drinking water collected in the distribution system, as given in Table 6 is, therefore specified when tested in accordance with IS 1622.

4.2 Virological Requirements

4.2.1 Ideally, all samples taken from the distribution

Table 1 Organoleptic and Physical Parameters
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 3025	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Colour, Hazen units, *Max*	5	15	Part 4	Extended to 15 only, if toxic substances are not suspected in absence of alternate sources
ii)	Odour	Agreeable	Agreeable	Part 5	a) Test cold and when heated b) Test at several dilutions
iii)	*p*H value	6.5-8.5	No relaxation	Part 11	—
iv)	Taste	Agreeable	Agreeable	Parts 7 and 8	Test to be conducted only after safety has been established
v)	Turbidity, NTU, *Max*	1	5	Part 10	—
vi)	Total dissolved solids, mg/l, *Max*	500	2 000	Part 16	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Aluminium (as Al), mg/l, *Max*	0.03	0.2	IS 3025 (Part 55)	—
ii)	Ammonia (as total ammonia-N), mg/l, *Max*	0.5	No relaxation	IS 3025 (Part 34)	—
iii)	Anionic detergents (as MBAS) mg/l, *Max*	0.2	1.0	Annex K of IS 13428	—
iv)	Barium (as Ba), mg/l, *Max*	0.7	No relaxation	Annex F of IS 13428* or IS 15302	—
v)	Boron (as B), mg/l, *Max*	0.5	1.0	IS 3025 (Part 57)	—
vi)	Calcium (as Ca), mg/l, *Max*	75	200	IS 3025 (Part 40)	—
vii)	Chloramines (as Cl_2), mg/l, *Max*	4.0	No relaxation	IS 3025 (Part 26)* or APHA 4500-Cl G	—
viii)	Chloride (as Cl), mg/l, *Max*	250	1 000	IS 3025 (Part 32)	—
ix)	Copper (as Cu), mg/l, *Max*	0.05	1.5	IS 3025 (Part 42)	—
x)	Fluoride (as F) mg/l, *Max*	1.0	1.5	IS 3025 (Part 60)	—
xi)	Free residual chlorine, mg/l, *Min*	0.2	1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l
xii)	Iron (as Fe), mg/l, *Max*	0.3	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xiii)	Magnesium (as Mg), mg/l, *Max*	30	100	IS 3025 (Part 46)	—
xiv)	Manganese (as Mn), mg/l, *Max*	0.1	0.3	IS 3025 (Part 59)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xv)	Mineral oil, mg/l, *Max*	0.5	No relaxation	Clause **6** of IS 3025 (Part 39) Infrared partition method	—
xvi)	Nitrate (as NO_3), mg/l, *Max*	45	No relaxation	IS 3025 (Part 34)	—
xvii)	Phenolic compounds (as C_6H_5OH), mg/l, *Max*	0.001	0.002	IS 3025 (Part 43)	—
xviii)	Selenium (as Se), mg/l, *Max*	0.01	No relaxation	IS 3025 (Part 56) or IS 15303*	—
xix)	Silver (as Ag), mg/l, *Max*	0.1	No relaxation	Annex J of IS 13428	—
xx)	Sulphate (as SO_4) mg/l, *Max*	200	400	IS 3025 (Part 24)	May be extended to 400 provided that Magnesium does not exceed 30
xxi)	Sulphide (as H_2S), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 29)	—
xxii)	Total alkalinity as calcium carbonate, mg/l, *Max*	200	600	IS 3025 (Part 23)	—
xxiii)	Total hardness (as $CaCO_3$), mg/l, *Max*	200	600	IS 3025 (Part 21)	—
xxiv)	Zinc (as Zn), mg/l, *Max*	5	15	IS 3025 (Part 49)	—

NOTES

1 In case of dispute, the method indicated by '*' shall be the referee method.

2 It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

Table 3 Parameters Concerning Toxic Substances

(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Cadmium (as Cd), mg/l, *Max*	0.003	No relaxation	IS 3025 (Part 41)	—
ii)	Cyanide (as CN), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 27)	—
iii)	Lead (as Pb), mg/l, *Max*	0.01	No relaxation	IS 3025 (Part 47)	—
iv)	Mercury (as Hg), mg/l, *Max*	0.001	No relaxation	IS 3025 (Part 48)/ Mercury analyser	—
v)	Molybdenum (as Mo), mg/l, *Max*	0.07	No relaxation	IS 3025 (Part 2)	—
vi)	Nickel (as Ni), mg/l, *Max*	0.02	No relaxation	IS 3025 (Part 54)	—
vii)	Pesticides, µg/l, *Max*	See Table 5	No relaxation	See Table 5	—
viii)	Polychlorinated biphenyls, mg/l, *Max*	0.000 5	No relaxation	ASTM 5175*	— or APHA 6630
ix)	Polynuclear aromatic hydro-carbons (as PAH), mg/l, *Max*	0.000 1	No relaxation	APHA 6440	—
x)	Total arsenic (as As), mg/l, *Max*	0.01	0.05	IS 3025 (Part 37)	—
xi)	Total chromium (as Cr), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 52)	—
xii)	Trihalomethanes:				
	a) Bromoform, mg/l, *Max*	0.1	No relaxation	ASTM D 3973-85* or APHA 6232	—
	b) Dibromochloromethane, mg/l, *Max*	0.1	No relaxation	ASTM D 3973-85* or APHA 6232	—
	c) Bromodichloromethane, mg/l, *Max*	0.06	No relaxation	ASTM D 3973-85* or APHA 6232	—
	d) Chloroform, mg/l, *Max*	0.2	No relaxation	ASTM D 3973-85* or APHA 6232	—

NOTES

1 In case of dispute, the method indicated by '*' shall be the referee method.

2 It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under ‘acceptable’ render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source’ in col 4, above which the sources will have to be rejected.

Table 4 Parameters Concerning Radioactive Substances

(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 14194	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Radioactive materials:				
	a) Alpha emitters Bq/l, *Max*	0.1	No relaxation	Part 2	—
	b) Beta emitters Bq/l, *Max*	1.0	No relaxation	Part 1	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under ‘acceptable’ render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under ‘permissible limit in the absence of alternate source’ in col 4, above which the sources will have to be rejected.

Table 5 Pesticide Residues Limits and Test Method

(*Foreword* and *Table* 3)

Sl No.	Pesticide	Limit µg/l	Method of Test, Ref to	
			USEPA	AOAC/ ISO
(1)	(2)	(3)	(4)	(5)
i)	Alachlor	20	525.2, 507	—
ii)	Atrazine	2	525.2, 8141 A	—
iii)	Aldrin/ Dieldrin	0.03	508	—
iv)	Alpha HCH	0.01	508	—
v)	Beta HCH	0.04	508	—
vi)	Butachlor	125	525.2, 8141 A	—
vii)	Chlorpyriphos	30	525.2, 8141 A	—
viii)	Delta HCH	0.04	508	—
ix)	2,4- Dichlorophenoxyacetic acid	30	515.1	—
x)	DDT (*o, p* and *p, p* – Isomers of DDT, DDE and DDD)	1	508	AOAC 990.06
xi)	Endosulfan (alpha, beta, and sulphate)	0.4	508	AOAC 990.06
xii)	Ethion	3	1657 A	—
xiii)	Gamma — HCH (Lindane)	2	508	AOAC 990.06
xiv)	Isoproturon	9	532	—
xv)	Malathion	190	8141 A	—
xvi)	Methyl parathion	0.3	8141 A	ISO 10695
xvii)	Monocrotophos	1	8141 A	—
xviii)	Phorate	2	8141 A	—

NOTE — Test methods are for guidance and reference for testing laboratory. In case of two methods, USEPA method shall be the reference method.

Table 6 Bacteriological Quality of Drinking Water[1)]

(*Clause* 4.1.1)

Sl No.	Organisms	Requirements
(1)	(2)	(3)
i)	*All water intended for drinking*:	
	a) *E. coli* or thermotolerant coliform bacteria[2), 3)]	Shall not be detectable in any 100 ml sample
ii)	*Treated water entering the distribution system*:	
	a) *E. coli* or thermotolerant coliform bacteria[2)]	Shall not be detectable in any 100 ml sample
	b) Total coliform bacteria	Shall not be detectable in any 100 ml sample
iii)	*Treated water in the distribution system*:	
	a) *E. coli* or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml sample
	b) Total coliform bacteria	Shall not be detectable in any 100 ml sample

[1)]Immediate investigative action shall be taken if either *E.coli* or total coliform bacteria are detected. The minimum action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause shall be determined by immediate further investigation.

[2)]Although, *E. coli* is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests shall be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of rural water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies.

[3)]It is recognized that, in the great majority of rural water supplies in developing countries, faecal contamination is widespread. Under these conditions, the national surveillance agency should set medium-term targets for progressive improvement of water supplies.

system including consumers' premises, should be free from virus.

4.2.2 None of the generally accepted sewage treatment methods yield virus-free effluent. Although a number of investigators have found activated sludge treatment to be superior to trickling filters from this point of view, it seems possible that chemical precipitation methods will prove to be the most effective.

4.2.3 Virus can be isolated from raw water and from springs, enterovirus, reovirus, and adenovirus have been found in water, the first named being the most resistant to chlorination. If enterovirus are absent from chlorinated water, it can be assumed that the water is safe to drink. Some uncertainty still remains about the virus of infectious hepatitis, since it has not so far been isolated but in view of the morphology and resistance of enterovirus it is likely that, if they have been inactivated hepatitis virus will have been inactivated also.

4.2.4 An exponential relationship exists between the rate of virus inactivation and the redox potential. A redox potential of 650 mV (measured between platinum and calomel electrodes) will cause almost instantaneous inactivation of even high concentrations of virus. Such a potential can be obtained with even a low concentration of free chlorine, but only with an extremely high concentration of combined chlorine. This oxidative inactivation may be achieved with a number of other oxidants also, for example, iodine, ozone and potassium permanganate, but the effect of the oxidants will always be counteracted, if reducing components, which are mainly organic, are present. As a consequence, the sensitivity of virus towards disinfectants will depend on the *milieu* just as much as on the particular disinfectant used.

4.2.5 Viruses are generally resistant to disinfectants as well as get protected on account of presence of particulate and organic matter in water. Because the difference between the resistance of coliform organisms and of virus to disinfection by oxidants increases with increasing concentration of reducing components, for example, organic matter, it cannot be assumed that the absence of available coliform organisms implies freedom from active virus under circumstances where a free chlorine residual cannot be maintained. Sedimentation and slow sand filtration in themselves may contribute to the removal of virus from water.

4.2.6 In practice, >0.5 mg/l of free chlorine for 1 h is sufficient to inactivate virus, even in water that was originally polluted provided the water is free from particulates and organic matter.

4.2.7 MS2 phage are indicator of viral contamination in drinking water. MS2 phage shall be absent in 1 litre of water when tested in accordance with USEPA method 1602. If MS2 phage are detected in the drinking water, virological examination shall be done by the Polymerase Chain Reaction (PCR) method for virological examination as given in Annex B. USEPA method in Manual of Method for Virology Chapter 16, June 2001 shall be the alternate method. If viruses are detected, the cause shall be determined by immediate further investigation.

4.3 Biological Requirements

4.3.1 Ideally, all samples taken including consumers premises should be free from biological organisms. Biological examination is of value in determining the causes of objectionable tastes and odours in water and controlling remedial treatments, in helping to interpret the results of various chemical analysis, and in explaining the causes of clogging in distribution pipes and filters. In some instances, it may be of use in demonstrating that water from one source has been mixed with that from another.

4.3.2 The biological qualities of water are of greater importance when the supply has not undergone the conventional flocculation and filtration processes, since increased growth of methane-utilizing bacteria on biological slimes in pipes may then be expected, and the development of bryozoal growths such as *Plumatella* may cause operational difficulties.

4.3.3 Some of the animalcules found in water mains may be free-living in the water, but others such as *Dreissena* and *Asellus* are more or less firmly attached to the inside of the mains. Although these animalcules are not themselves pathogenic, they may harbour pathogenic organisms or virus in their intestines, thus protecting these pathogens from destruction by chlorine.

4.3.4 Chlorination, at the dosages normally employed in waterworks, is ineffective against certain parasites, including amoebic cysts; they can be excluded only by effective filtration or by higher chlorine doses than can be tolerated without subsequent dechlorination. *Amoebiasis* can be conveyed by water completely free from enteric bacteria; microscopic examination after concentration is, therefore, the only safe method of identification.

4.3.5 Strict precautions against back-syphonage and cross-connections are required, if amoebic cysts are found in a distribution system containing tested water.

4.3.6 The *cercariae of schistosomiasis* can be detected by similar microscopic examination, but there is, in

any case, no evidence to suggest that this disease is normally spread through piped water supplies.

4.3.7 The cyclops vector of the embryos of *Dracunculus medinensis* which causes dracontiasis or Guinea-worm disease can be found in open wells in a number of tropical areas. They are identifiable by microscopic examination. Such well supplies are frequently used untreated, but the parasite can be relatively easily excluded by simple physical improvements in the form of curbs, drainage, and apron surrounds and other measures which prevent physical contact with the water source.

4.3.8 Cryptosporidium shall be absent in 10 liter of water when tested in accordance with USEPA method 1622 or USEPA method 1623* or ISO 15553 : 2006.

4.3.9 Giardia shall be absent in 10 liter of water when tested in accordance with USEPA method 1623* or ISO 15553 : 2006.

4.3.10 The drinking water shall be free from microscopic organisms such as algae, zooplanktons, flagellates, parasites and toxin producing organisms. An illustrative (and not exhaustive) list is given in Annex C for guidance.

NOTE — In case of dispute, the method indicated by '*' in **4.3.8** and **4.3.9** shall be referee method.

5 SAMPLING

Representative samples of water shall be drawn as prescribed in IS 1622 and IS 3025 (Part 1).

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1622 : 1981	Methods of sampling and microbiological examination of water (*first revision*)
3025	Methods of sampling and test (physical and chemical) for water and waste water:
(Part 1) : 1987	Sampling (*first revision*)
(Part 2) : 2002	Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy
(Part 4) : 1983	Colour (*first revision*)
(Part 5) : 1983	Odour (*first revision*)
(Part 7) : 1984	Taste threshold (*first revision*)
(Part 8) : 1984	Tasting rate (*first revision*)
(Part 10) : 1984	Turbidity (*first revision*)
(Part 11) : 1983	*p*H value (*first revision*)
(Part 16) : 1984	Filterable residue (total dissolved solids) (*first revision*)
(Part 21) : 1983	Total hardness (*first revision*)
(Part 23) : 1983	Alkalinity (*first revision*)
(Part 24) : 1986	Sulphates (*first revision*)
(Part 26) : 1986	Chlorine residual (*first revision*)
(Part 27) : 1986	Cyanide (*first revision*)
(Part 29) : 1986	Sulphide (*first revision*)
(Part 32) : 1988	Chloride (*first revision*)
(Part 34) : 1988	Nitrogen (*first revision*)
(Part 37) : 1988	Arsenic (*first revision*)
(Part 39) : 1989	Oil and grease
(Part 40) : 1991	Calcium
(Part 41) : 1992	Cadmium (*first revision*)
(Part 42) : 1992	Copper (*first revision*)
(Part 43) : 1992	Phenols (*first revision*)
(Part 46) : 1994	Magnesium
(Part 47) : 1994	Lead
(Part 48) : 1994	Mercury
(Part 49) : 1994	Zinc
(Part 52) : 2003	Chromium
(Part 53) : 2003	Iron
(Part 54) : 2003	Nickel
(Part 55) : 2003	Aluminium
(Part 56) : 2003	Selenium
(Part 57) : 2005	Boron
(Part 59) : 2006	Manganese
(Part 60) : 2008	Fluoride
13428 : 2003	Packaged natural mineral water — Specification (*first revision*)
14194	Radionuclides in environmental samples — Method of estimation:
(Part 1) : 1994	Gross beta activity measurement
(Part 2) : 1994	Gross alpha activity measurement
15302 : 2002	Determination of aluminium and barium in water by direct nitrous oxide-acetylene flame atomic absorption spectrometry
15303 : 2002	Determination of antimony, iron and selenium in water by electrothermal atomic absorption spectrometry

ANNEX B

(*Clause* 4.2.7)

POLYMERASE CHAIN REACTION (PCR) METHOD

B-1 GENERAL

The method involves the concentration of viruses from 100 litre of drinking water to 1 ml by membrane filter technique. The concentrate is subjected to amplification using polymerase chain reaction (PCR) and primers based on highly conserved regions of viral genomes. This method can detect as low as 10 genome copies. Stringent precautions are needed to avoid contamination with amplified DNA products leading to false positive reactions. Detection of hepatitis A virus (HAV) RNA and enterovirus (EV) RNA is considered as an indication of presence of viruses in water. Steps involved include concentration of water, RNA extraction, complementary DNA (cDNA) synthesis and PCR.

B-2 CONCENTRATION OF DRINKING WATER

B-2.1 Apparatus

B-2.1.1 *Pressure Pump*

B-2.1.2 *Membrane Filter Assembly with 144 mm Diameter with Tripod Stand*

B-2.1.3 *Pressure Vessel (50 litre capacity) with Pressure Gauge*

B-2.1.4 *Inter-connecting Pressure Tubes*

B-2.2 Reagents

Autoclaved double distilled water shall be used for the preparation of reagents/buffers in this study.

B-2.2.1 *Aluminium Chloride*

B-2.2.2 *HCl/NaOH Urea (Extra Pure)*

B-2.2.3 *Disodium Hydrogen Phosphate* ($Na_2HPO_4.2H_2O$) — 0.2 M, filter sterilized.

B-2.2.4 *Sodium Dihydrogen Phosphate* ($NaH_2PO_4.2H_2O$) — 0.2 M, filter sterilized.

B-2.2.5 *Citric Acid* — 0.1 M, filter sterilized.

B-2.2.6 *L-Arginine* — 0.5 M, filter sterilized.

B-2.2.7 *Urea-Arginine Phosphate Buffer* (*U-APB*) — Mix 4.5 g of urea with 2 ml of 0.2 M NaH_2PO_4 and 2 ml of 0.5 M L - Arginine and make up the volume to 50 ml with sterile distilled water. The *p*H of the eluent shall be 9.0.

B-2.2.8 *Magnesium Chloride* ($MgCl_2$) — 1 M.

B-2.2.9 *McII Vaines Buffer* (*p*H *5.0*) — Mix 9.7 ml of 0.1 M citric acid with 10.3 ml of 0.2 M $Na_2HPO_4.2H_2O$ under sterile conditions.

B-2.3 Procedure

Filter 100 litre of drinking water sample through membrane filter assembly using either positively charged membrane of 144 mm diameter or 0.22 micron diameter pore size nitrocellulose membrane. For positively charged membrane the test water *p*H need not be adjusted. But for the 0.22 micron nitrocellulose membrane adjust the *p*H to 3.5 after adding the aluminium chloride as a coagulant to a final concentration of 0.000 5 M.

At lower *p*H pass the water through the membrane. The flow rate shall be 40 litre/h approximately. After the completion of the filtration, elute the adsorbed particles using 100 ml of urea-arginine phosphate buffer (U-APB). Precipitate the suspended particles using 1 ml of magnesium chloride (1 M). Dissolve the resultant precipitate centrifuged out of the sample in 800-1.0 ml of McII vaines buffer. The processed sample can be stored at refrigerator until required.

B-3 RNA EXTRACTION

B-3.1 Apparatus

B-3.1.1 *Cooling Centrifuge*

B-3.1.2 *Deep Freezer (–20°C)*

B-3.1.3 *Vortex Mixer*

B-3.1.4 *Pipette Man*

B-3.2 Reagents

B-3.2.1 *Cetyl Trimethyl Ammonium Bromide (CTAB) Buffer*

CTAB	:	1 percent
Sodium Dodecyl Sulphate (SDS)	:	1 percent
EDTA	:	20 mM
Sodium Chloride	:	1 M

B-3.2.2 *Phenol, Chloroform and Isoamylalcohol in the ratio of 25:24:1 (PCI)*

B-3.2.3 *Ethanol*

B-3.2.4 *TE Buffer (p*H *8.0)*

Tris base	:	1 M
EDTA	:	0.5 M

B-3.2.5 *Sodium Acetate* — 3 M.

B-3.3 Procedure

Treat 300 µl of concentrated water sample with equal volume of CTAB and 1/10th volume of PCI. Vortex and centrifuge at 5 000 × g for 30 min at 4°C. Add 1/10th volume of 3 M sodium acetate and double the volume of cold ethanol to the aqueous layer. Keep the mixture at either at –20°C for overnight or in liquid nitrogen for 2-5 min. Centrifuge at 10 000 × g, for 30 min at 4°C. Discard the supernatant and air dry the pellet and dissolve it in 20 µl TE buffer.

B-4 COMPLEMENTARY DNA (c DNA) SYNTHESIS

B-4.1 Apparatus

B-4.1.1 *PCR Machine*

B-4.1.2 *Deep Freezer (–20°C)*

B-4.2 Reagents

B-4.2.1 *cDNA Synthesis Kit*

B-4.3 Procedure

Suspend the extracted RNA in 20 µl of cDNA reaction mixture, which consists of 4 µl of 5X reverse transcriptase reaction buffer [250 mM TRIS–HCl (*p*H 8.5), 40 mM KCl, 150 mM $MgCl_2$, 5 mM dithiothreitol (DTT)], 0.5 µl of 10 mM deoxynucleotide phosphate (dNTP), 2 µl of hexa nucleotide mixture, 1 µl of 25 U of Maloney Murine Leukaemia Virus (M-MuLV) reverse transcriptase, 0.5 µl of 20 U of human placental RNase inhibitor. Heat the reaction mixture to 95°C for 5 min and rapidly chill on ice, this is followed by the addition of 1 µl (25 U/µl) of M-MuLV reverse transcriptase. Incubate the reaction mixture as given by the manufacturer of the kit and quickly chill the reaction tube on ice.

B-5 PCR AMPLIFICATION

B-5.1 Apparatus

B-5.1.1 *PCR Machine*

B-5.1.2 *Deep Freezer (–20°C)*

B-5.1.3 *Micropippette*

B-5.2 Reagents

B-5.2.1 *Primers for EV and HAV*

EV sense primer, 5' — TCC TCC GGC CCC TGA ATG CG — 3'

antisense primer, 5' — ATT GTC ACC ATA AGC AGC CA — 3'

HAV sense primer, 5' — GTTTT GCTCC TCTTT ATCAT GCTAT G-3'

antisense primer, 5' — GGAAA TGTCT CAGGT ACTTT CTTTG-3'

B-5.2.2 *PCR Master Mix*

B-5.2.3 *Mineral Oil*

B-5.3 Procedure

B-5.3.1 *PCR Amplification for Hepatitis A Virus (HAV)*

In 5 µl of cDNA, add 95 µl of a PCR Master Mix (10 mM TRIS–HCl (*p*H 8.3), 50 mM KCl, 2.5 mM $MgCl_2$, 0.01 percent gelatin (1× PCR buffer), 200 µM of each dNTP, 1.5 U of *Thermus aquaticus* polymerase). Add 25 pico moles of sense and antisense oligonucleotide primers of HAV and overlay with mineral oil. Appropriate positive and negative controls shall be included with each run. Set the following reaction at thermo cycler:

Denaturation at 94°C for 2 min

Denaturation for	1.0 min	at 94°C	} 35 cycles
Annealing for	1.0 min	at 57°C	
Extension for	1.3 min	at 72°C	

Final extension at 72°C for 7 min.

B-5.3.2 *PCR Amplification for Enterovirus (EV)*

In 5 µl of cDNA, add 95 µl of a PCR Master Mix (10 mM TRIS–HCl (*p*H 8.3), 50 mM KCl, 2.5 mM $MgCl_2$, 0.01 percent gelatin (1X PCR buffer), 200 µM of each dNTP, 1.5 U of *Thermus aquaticus* polymerase). Add 25 pico moles of sense and antisense oligonucleotide primers of EV and overlay with mineral oil. Appropriate positive and negative controls shall be included with each run. Set the following reaction at thermo cycler:

Denaturation at 94°C for 2 min

Denaturation for	1.0 min	at 94°C	} 35 cycles
Annealing for	1.0 min	at 42°C	
Extension for	2.0 min	at 72°C	

Final extension at 72°C for 7 min.

B-6 AGAROSE GEL ELECTROPHORESIS

B-6.1 Apparatus

B-6.1.1 *Micropippette*

B-6.1.2 *Electrophoresis Apparatus*

B-6.1.3 *Gel Documentation System*

B-6.2 Reagents

B-6.2.1 *Running Buffer* — 50X TAE buffer

Tris base/Tris buffer : 121.00 g

Glacial acetic acid	:	28.55 ml
0.5 M EDTA	:	50 .00 ml
Distilled water (autoclaved)	:	300.45 ml

Make the final volume upto 1 000 ml with deionised distilled water, sterilize and store at 4°C. The final concentration for the preparation of agarose gel and to run the gel shall be 1X.

B-6.2.2 *Tracking Dye* — 6X bromophenol blue.

B-6.2.3 *Ethidium Bromide* — 0.5 µg/ml.

B-6.3 Procedure

Run the PCR amplified product of EV and HAV on 1.5 percent agarose gel using 1X TAE buffer. Load 10 µl of amplified product after mixing it with 1 µl 10X loading dye. Run the molecular weight marker along with the samples. Run the electrophoresis at 100 V for 30 min. Stain the gel with ethidium bromide (0.5 µl/ml) for 20 min. Wash it with distilled water and view under UV transilluminator and photograph the gel to analyse the band pattern. EV gives the band as 155 base pair and the HAV gives band as 225 base pair.

ANNEX C

(*Clause* 4.3.10)

ILLUSTRATIVE LIST OF MICROSCOPIC ORGANISMS PRESENT IN WATER

Sl No. (1)	*Classification of Microscopic Organism* (2)	*Group and Name of the Organism* (3)	*Habitat* (4)	*Effect of the Organisms and Significance* (5)
i)	Algae	a) Chlorophyceae:		
		1) *Species of* Coelastrum, Gomphospherium, Micractinium, Mougeotia, Oocystis, Euastrum, Scenedesmus, Actinastrum, Gonium, Eudorina Pandorina, Pediastrum, Zygnema, Chlamydomonas, Careteria, Chlorella, Chroococcus, Spirogyra, Tetraedron, Chlorogonium, Stigeoclonium	Polluted water, impounded sources	Impart colouration
		2) *Species of* Pandorina, Volvox, Gomphospherium, Staurastrum, Hydrodictyon, Nitella	Polluted waters	Produce taste and odour
		3) *Species of* Rhizoclonium, Cladothrix, Ankistrodesmus, Ulothrix, Micrasterias, Chromulina	Clean water	Indicate clean condition
		4) *Species of* Chlorella, Tribonema, Clostrium, Spirogyra, Palmella	Polluted waters, impounded sources	Clog filters and create impounded difficulties
		b) Cyanophyceae:		
		1) *Species of* Anacystis and Cylindrospermum	Polluted waters	Cause water bloom and impart colour
		2) *Species of* Anabena, Phormidium, Lyngbya, Arthrospira, Oscillatona	Polluted waters	Impart colour
		3) *Species of* Anabena, Anacystis, Aphanizomenon	Polluted waters, impounded sources	Produce taste and odour
		4) *Species of* Anacystis, Anabena, Coelospherium, Cleotrichina, Aphanizomenon	Polluted waters	Toxin producing
		5) *Species of* Anacystis, Rivularia, Oscillatoria, Anabena	Polluted waters	Clog filters

Sl No. (1)	*Classification of Microscopic Organism* (2)	*Group and Name of the Organism* (3)	*Habitat* (4)	*Effect of the Organisms and Significance* (5)
		6) *Species of* Rivularia	Calcareous waters and also rocks	Bores rocks and calcareous strata and causes matted growth
		7) *Species of* Agmenellum, Microcoleus, Lemanea	Clean waters	Indicators of purification
		c) Diatoms (Bacillareophyceae):		
		1) *Species of* Fragillaria, Stephanodiscus, Stauroneis	—	Cause discoloration
		2) *Species of* Asterionella, Tabellaria	Hill streams high altitude, torrential and temperate waters	Taste and odour producing clog filters
		3) *Species of* Synedra and Fragillavia	Polluted waters	Taste and odour producing
		4) *Species of* Nitzchia, Gomphonema	Moderately polluted waters	Cause discoloration
		5) *Species of* Cymbela, Synedra, Melosira, Navicula, Cyclotella, Fragillaria, Diatoma, Pleurogsigma	Rivers and streams impounded sources	Clog filters and cause operational difficulties
		6) *Species of* Pinmularia, Surinella, Cyclotella, Meridion, Cocconeis	Clean waters	Indicators of purification
		d) Xanthophyceae:		
		Species of Botryococcus	Hill streams, high altitude and temperate waters	Produces coloration
ii)	Zooplankton	a) Protozoa:		
		1) Amoeba, Giardia Lamblia Arcella, Difflugia, Actinophrys	Polluted waters	Pollution indicators
		2) Endamoeba, Histolytica	Sewage and activated sludge	Parasitic and pathogenic
		b) Ciliates:		
		Paramoecium, Vorticella, Carchesium, Stentor, Colpidium, Coleps, Euplotes, Colopoda, Bodo	Highly polluted waters, sewage and activated sludge	Bacteria eaters
		c) Crustacea:		
		1) Bosmina, Daphnia	Stagnant polluted waters	Indicators of pollution
		2) Cyclops	Step wells in tropical climate	Carrier host of guinea worm
iii)	Rotifers	a) Rotifers:		
		Anurea, Rotaria, Philodina	Polluted and Algae laden waters	Feed on algae
		b) Flagellates:		
		1) Ceratium, Glenodinium, Peridinium Dinobryon	Rocky strata, iron bearing and acidic waters	Impart colour and fishy taste
		2) Euglena, Phacus	Polluted waters	Impart colour

Sl No.	*Classification of Microscopic Organism*	*Group and Name of the Organism*	*Habitat*	*Effect of the Organisms and Significance*
(1)	(2)	(3)	(4)	(5)
iv)	Miscellaneous Organisms	a) Sponges, Hydra	Fresh water	Clog filters and affect purification systems
		b) Tubifex, Eristalls, Chironomids	Highly polluted waters, sewage and activated sludge and bottom deposits	Clog filters and render water unaesthetic
		c) Plumatella	Polluted waters	Produces biological slimes and causes filter operational difficulties
		c) Dreissena, Asellus	Polluted waters	Harbour pathogenic organisms

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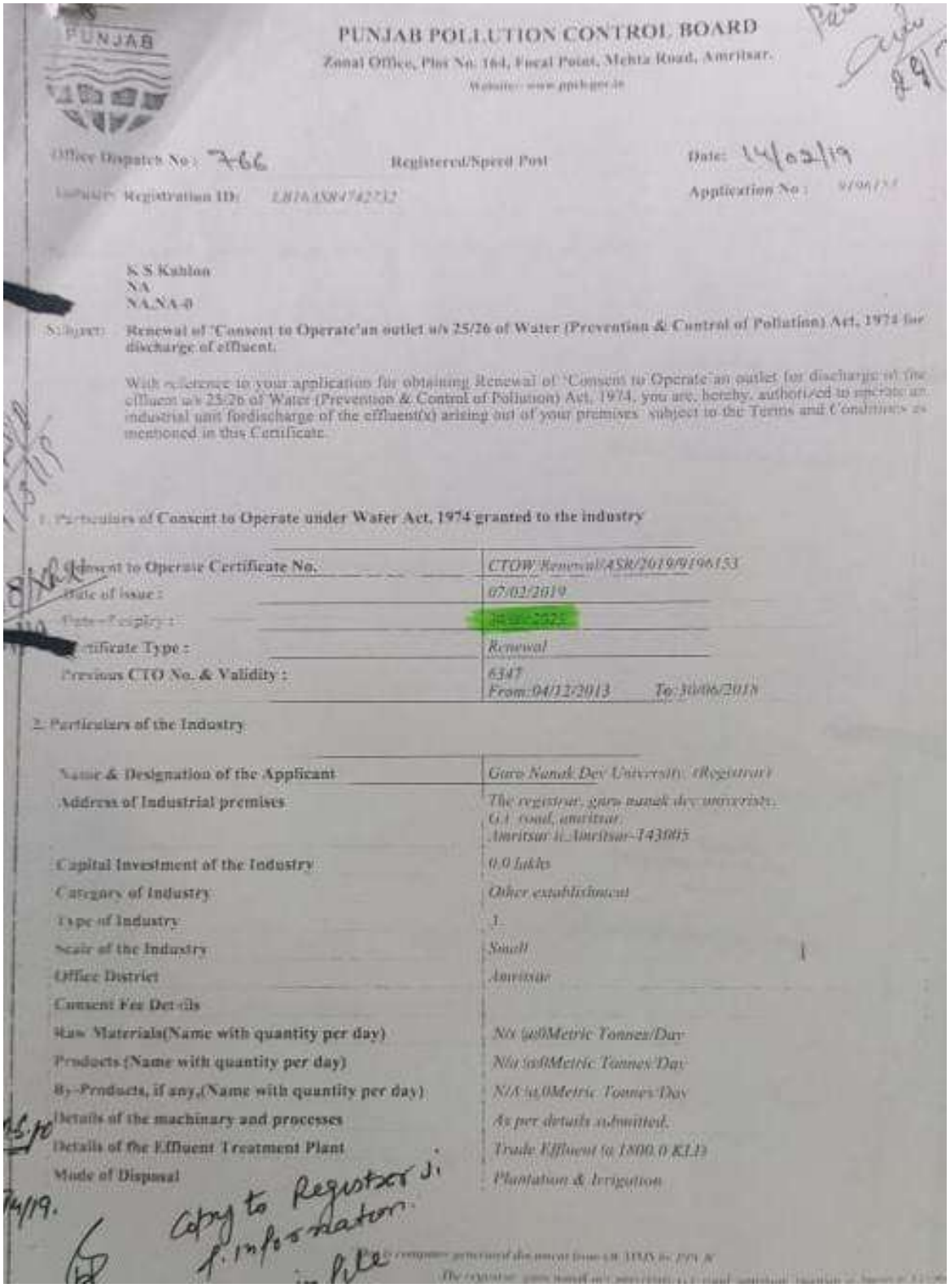

PUNJAB POLLUTION CONTROL BOARD

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Office Dispatch No: 766 Registered/Speed Post Date: 14/02/19

Registration ID: EM1638847427J2 Application No: 9196153

S S Kahlon
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Subject: Renewal of 'Consent to Operate'an outlet u/s 25/26 of Water (Prevention & Control of Pollution) Act, 1974 for discharge of effluent.

With reference to your application for obtaining Renewal of 'Consent to Operate'an outlet for discharge of the effluent u/s 25/26 of Water (Prevention & Control of Pollution) Act, 1974, you are, hereby, authorized to operate an industrial unit fordischarge of the effluent(s) arising out of your premises subject to the Terms and Conditions as mentioned in this Certificate.

1. Particulars of Consent to Operate under Water Act, 1974 granted to the industry

Consent to Operate Certificate No.	CTOW Renewal/ASR/2019/9196153
Date of issue :	07/02/2019
Date of expiry :	30/06/2023
Certificate Type :	Renewal
Previous CTO No. & Validity :	6347 From:04/12/2013 To:30/06/2018

2. Particulars of the Industry

Name & Designation of the Applicant	Guru Nanak Dev University, (Registrar)
Address of Industrial premises	The registrar, guru nanak dev university, G.T. road, amritsar Amritsar Ic Amritsar-143005
Capital Investment of the Industry	0.0 Lakhs
Category of Industry	Other establishment
Type of Industry	3
Scale of the Industry	Small
Office District	Amritsar
Consent Fee Details	
Raw Materials(Name with quantity per day)	N/A |a0Metric Tonnes/Day
Products (Name with quantity per day)	N/A |a0Metric Tonnes/Day
By-Products, if any,(Name with quantity per day)	N/A |a0Metric Tonnes/Day
Details of the machinary and processes	As per details submitted.
Details of the Effluent Treatment Plant	Trade Effluent @ 1800.0 KLD
Mode of Disposal	Plantation & Irrigation

14/19.

Copy to Registor J. for info & action. File


Every
drop
counts!

Prepared by
Internal Quality Assurance Cell, Guru Nanak Dev University, Amritsar

GREEN ENERGY INITIATIVES

Guru Nanak Dev University
Amritsar
2020-2021

Preface

Energy audit of the Guru Nanak Dev University Campus has been conceded by a team for the period of May 2017 to April 2021. The audit has been carried out to assess the energy competence of the campus in terms of drop of energy consumption and efforts made for energy conservation practices. This audit to highlight the energy proficient appliances which sinked the expenditure on energy and paved ways to further the efforts and initiatives to reduce the energy consumption in future. The energy audit survey was conducted by Prof. (Dr.) M. L. Singh, Electronics Department, and the report was finalized by Prof. (Dr.) Ashwani Luthra, Director, IQAC, GNDU, Amritsar. The required data is supplied by the electricity department of the university. The energy requirements and consumption are analyzed for overall campus and for different appliances in different sections of the university such as academic departments, administrative buildings, residential areas and hostels. Electricity consumption by different appliances such as tubes, fan, A.Cs, electronic instruments, etc. is also considered for the audit. The audit has helped the team to suggest the ways forwards to look for options relating to green energy production and reduced consumption of conventional energy.

1. INTRODUCTION

Higher education institutions (HEIs) are the driving forces to nation building. They act as role models for the society and communities to execute the innovative techniques and technologies developed and adopted by them to benefit the financial health and environment of the nation. Hence, responsibilities have been fixed on the HEIs to act upon to achieve the sustainable development goals (SDGs) and their targets mandated to be achieved by 2030. Amongst the seventeen SDGs suggested by the United Nations, SDG 7 specifically focuses on 'Sustainable and Green Energy'. An audit of the existing energy scenario of a HEI will help it to develop energy saving/ conservation strategies along with the use of green energy options.

Energy audit exercise is undertaken for Guru Nanak Dev University, Amritsar to identify energy efficiency potentials and develop modifications that will reduce the use of conventional energy and promote maximum use of green energy leading to higher financial and environmental savings. The report incorporates an account of total energy consumption, its distributive pattern, potential savings through various design and technological interventions, and adoption of innovative energy conservation and renewable energy production techniques and technologies. The report highlights the innovative mechanisms adopted by the university to contribute to green energy sources and their optimum utilization to reduce its contribution to environmental damage and pollution. The audit identifies the areas and components where use of conventional energy needs to be replaced with green energy sources or energy conservation practices. The Internal Energy Audit of the university has been carried out by collecting the periodic data for May 2017 to April 2021 (refer annexure-I) about the consumption of electricity supplied by Punjab State Power Corporation Limited, New Delhi.

2. Energy Consumption

The university is committed to reduce its consumption of conventional energy by adopting different green initiatives in the campus. It has reduced its consumption of conventional energy from 74.78 lakh kilowatt in 2017-2018 to 44.17 lakh kilowatt (kWh) in 2020-2021, a fall of about 41 percent in 2017-2021 (refer table 1). The table reveals that that there was a marginal reduction in energy consumption of about 4 percent in 2018-2019, in comparison to the energy consumption in May 2017-2018. In 2019-2020, the University initiated its major conservation strategies through installation of solar water heaters and energy efficient LED light sources in its administrative, academic, and hostel buildings along with street lighting system. Hence, the conventional power consumption reduced to 46.30 lakh kWh, showing a reduction by almost 38 percent in 2019-2020, in comparison to that in 2017-2018. The year 2020-2021 witnessed energy consumption reduction to 44.17 lakh kWh, a fall by about 4.6 percent, in comparison to 2019-2020.

Table 1: Punjab State Power Corporation Limited (PSPCL) Energy Units Consumption

Period of Consumption	Total PSPCL Electricity Consumption (in Lakh Kilowatt)	Percentage Reduction in Electricity Consumption
May 2017 - April 2018	74.88	----
May 2018 - April 2019	71.88	- 4.01
May 2019 - April 2020	46.30	- 35.58
May 2020 - April 2021	44.17	- 4.60
Overall Reduction (May 2017 – April 2021)	30.71	- 41.01

Figure 1 indicates the conventional Punjab State Power Corporation Limited (PSPCL) energy consumption trends over the period of four years from May 2017 to April 2021. For clarity in data the energy consumption figures have been converted into whole numbers and units are lakhs of kilowatt.

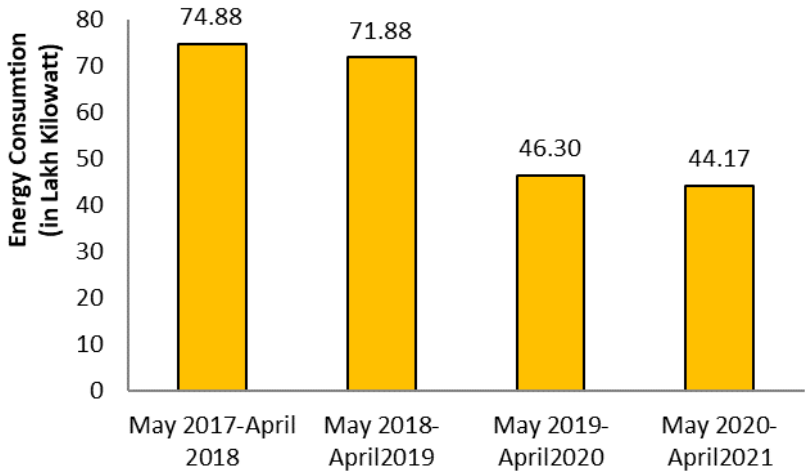


Figure 1: Periodic Conventional PSPCL Energy Consumption from May 2017 to April 2021

The details of electricity consumption for the four years (2017-2021) are described in annexure - I.

Green energy production initiative started in 2019 by installing 1.48 MW rooftop solar power generation plant, commissioned on 22/07/2019. In 2020-2021, the rooftop solar plant started working to its full capacity for the whole year. Rooftop solar power grid connected plant was sanctioned by Solar Energy Corporation of India Ltd., Ministry of New and Renewable Energy, Government of India and installed by Azure Power Rooftop One Pvt. Ltd, New Delhi, under the RESCO Model, free of cost. Its operation and maintenance is to be looked after by Azure Power for the period of 25 years (refer annexure - II). From the date of commissioning of the project i.e. 22/07/2019 till April 2020 it produced 8.73 lakh kWh of renewable energy, which has risen to 14.8 lakh kWh after the solar power generation plants have started working at full capacity of for full year (refer table 2).

Table 2: Solar Power Units Generation

Period of Solar Power Generation	Solar Units Generated (Lakh kWh)
From the date of commissioning 22/07/2019 to April 2020	8.73
May 2020 – April 2021	14.80

All the units generated by rooftop solar power plants are consumed to meet the power demand of the university. In case all the units are not consumed, then the excessive energy generated goes back to the grid which is recorded in the two way energy meters installed. This helps in lowering the consumption of PSPCL conventional energy. The University is paying only INR 3.32 per unit kWh of the solar power generated. Details of solar powered energy generation is given in annexure - III.

Table 3 indicates that the whereas total electricity consumed was 74.88 lakh kWh units in 2017-2018, it reduced to 55.03 lakh kWh units in 2019-2020, of which 15.86 percent were solar power units. Operation of few new buildings in 2020-2021 increased the total power consumption to 58.95 lakh kWh units, of which 25.11 percent were solar power units. The university is committed to increase its contribution to energy conservation and green energy production strategies in future as well.

Table 3: Total PSPCL Units and Solar Power Units Consumption

Period of Consumption	Electricity Units Consumed (Lakh kWh)			Contribution of Solar Power (in percentage)
	PSPCL	Solar Power	Total	
May 2017- April 2018	74.88	Nil	74.88	Nil
May 2018 – April 2019	71.88	Nil	71.88	Nil
May 2019 – April 2020	46.30	8.73	55.03	15.86
May 2020 – April 2021	44.17	14.80	58.95	25.11

Figure 2 presents the graphical scenario of contribution of conventional and solar power in meeting the total electricity requirement of the university.

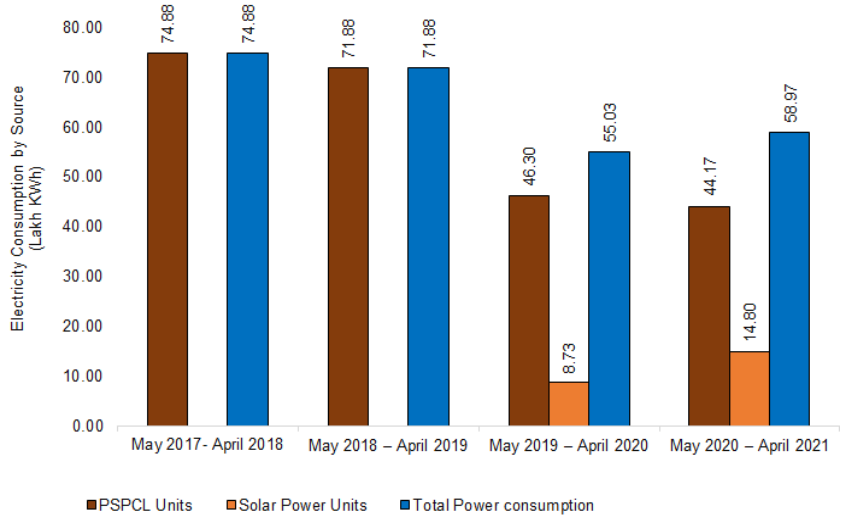


Figure 2: Periodic Consumption of Conventional PSPCL Energy & Renewable Solar Power Energy (May 2017 to April 2021)

2.1. Major Bifurcation of Electricity Energy Consumption

Table 4 and figure 3 show the major bifurcation of energy consumption in the university. Among this the energy consumption by academic and administrative departments is at the highest, consuming 2791071 kWh (45.53 percent) power during 2020-2021. About 2411301 kWh (39.33 percent) power is consumed by utilities, to include indoor stadium, gymnasiums, shops, swimming pools, canteens and other recreational facilities in the university.

Consumption by flood light used in AstroTurf is not added as these lights are not connected load. During the events these flood lights are powered by portable generators of 500 kVA capacity arranged by the sponsors. Residential area consumes about 928138 kWh (15.14 percent) electricity units, which is the minimum amongst the three users. So, the major efforts for reducing the electricity power consumption is to be targeted at the academic and recreational areas.

Table 4: Major Bifurcation of Electricity Consumption

Category	Consumption (kWh) (June 2020 to July 2021)	Percentage Contribution
Academic and Administrative Departments	2791071	45.53
Residential Area	928138	15.14
Utilities	2411301	39.33
Total	6130510	100.00

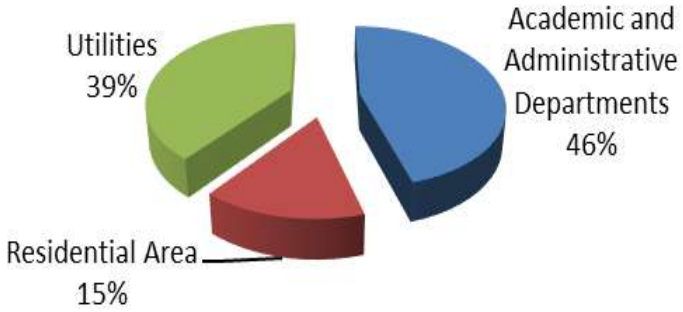


Figure 3: Major Bifurcation of Energy Consumption

Details of the power consumption by different uses has been calculated from annexure – IV.

2.2. Micro Bifurcation of Electricity Energy Consumption

Table 5 and figure 4 reveal the micro bifurcation of energy consumption by different appliances. It is clear that major consumer of electricity has been the cooling appliances, consuming 37.82 lakh kWh (61.80 percent) electricity units during 2020-2021. Cooling considers all the equipment such as standalone air conditioners, AC plants, water coolers, dessert coolers, refrigerators and fans. Lighting appliances, such as LED lights, fluorescent lights, sodium lights and other conventional lights, consume about 12.56 percent electricity.

Table 5: Micro Bifurcations of Electricity Consumption

Category	Consumption(kWh) (June 2020 to July 2021)	Percentage Contribution
Lighting	768888	12.56
Cooling	3782328	61.80
Water Pumping	728720	11.90
Wastewater Treatment	395280	6.46
Any other	445296	7.28
Total	6120512	100.00

Water pumping and wastewater treatment plant uses about 728720 kWh (11.90 percent) and 395280 kWh (6.46 percent) electricity. About 445296 kWh units of electricity is consumed by other appliances of the university.

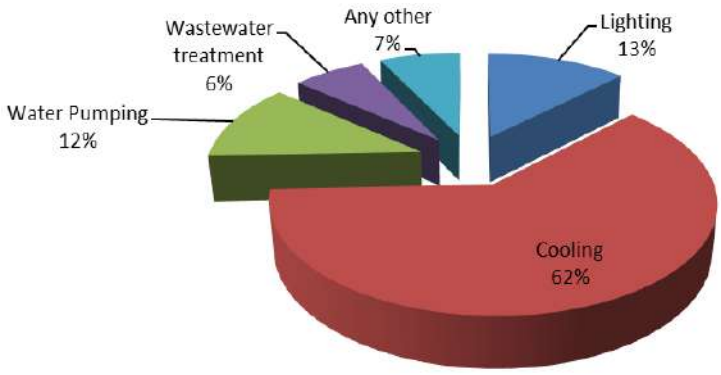


Figure 4: Micro Bifurcation of Energy Consumption

The university is making all its efforts to minimise the energy consumption on cooling equipment by adopting advanced technology cooling appliances. The consumption has been calculated taken into considerations the electric appliances with their load and approximate usage hours for the period of 12 months. The details of different kinds of loads is given in Annexure-V.

2.2.1. Cooling Equipment

Table 6 elaborates the energy consumption of the cooling equipment installed in the university campus. The energy consumptions because of the usage of this cooling equipment has been calculated for 12 months period and tabulated. Since there is no provision of energy meters for metering the consumptions due to the usage of these equipment separately, approximate usage hour and the load has been taken into account to calculate the consumption in a year (refer annexure - V).

It is clear from table 6 that about 13.31 kWh units (58.68 percent) of electricity is consumed by the air conditioners of the university. About 786240 kWh units (34.68 percent) of electricity is consumed by the fans in the hostels, departments. Remaining 6.63 percent electricity is used to run the AC plants, water coolers and desert coolers.

Table 6: Cooling Equipment Details

Cooling Equipment Type	Number	Tonnage	Power (in kW)	Running Hours per 12 months	Energy Consumption kWh for 12 months	
Air Conditioners	5	1 Ton	7.50	792	5940	1330560 (58.68%)
Air Conditioners	658	1.5 Ton	1480.50	792	1172556	
Air Conditioners	64	2 Ton	192.00	792	152064	
AC Plants	6	5.5 Ton	49.00	80	3920	26380 (1.16%)
AC Plant	3	11 Ton	49.00	80	3920	
AC Plant	4	12 Ton	72.00	120	8640	
AC Plant	10	16.5 Ton	247.50	40	9900	
Water Coolers	182	1.5 kW	273.00	360	98280	(4.33%)
Dessert Coolers	150	150 W	22.50	1152	25920	(1.14%)
Fans (in hostels)	2400	100 W	120.00	1456	349440	786240 (34.68%)
Fans (Departments)	3000	100 W	300.00	1456	436800	

Figure 5 presents the percentage of energy consumed by various cooling equipments in detail. It is clear that the 1.5 Ton ACs are the major consumers of electricity consuming about 52 percent of the total electricity consumed by cooling appliances. Fans in the departments and hostels consume about 19 percent and 15 percent of the electricity. The 2 tons air conditioners and water coolers consume about 7 percent and 4 percent electricity respectively. Every other appliance consumes less than 1 percent electricity.

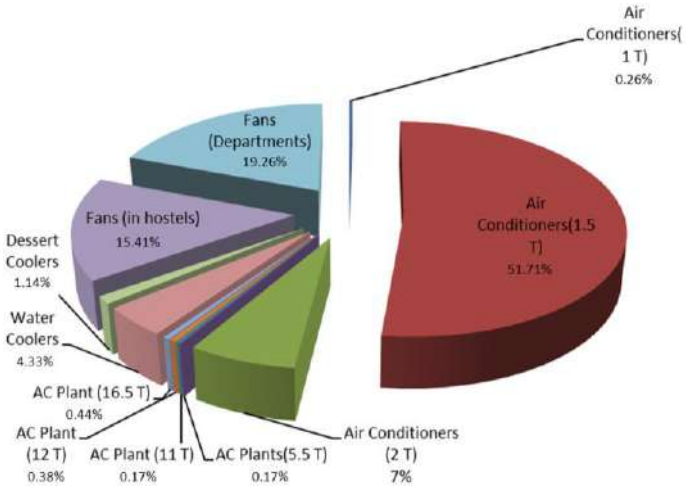


Figure 5: Energy Consumption by Major Cooling Equipments

It is estimated that if only 1.5 ton ACs are replaced by 20 percent more efficient equipments then about 2.34 lakh kWh energy can be saved annually. The old and worn out equipments are being replaced by more energy efficient equipment, which will help in lowering the energy consumption in due course of time.

3. GREEN ENERGY AND ENERGY CONSERVATION INITIATIVES

To make GNDU a green campus, several initiatives have been taken to produce green energy and to minimise the energy consumption. Following are some of the key initiatives taken by the university.

3.1. Rooftop PV Solar Power Plants

Total 26 rooftop solar power grid connected plants have been installed on the rooftops of 23 buildings (refer table 7). The capacity of the plants has been decided on the bases of rooftop area available without any shade throughout the day. Total capacity of these solar plants is 1.48 MWp and generate approximately 15 lakh kWh units of solar energy. The grid connected rooftop PV solar power plant has been sanctioned by Solar Power Corporation of India (SECI) under Renewable Energy Service Company (RESCO) model and installed by Azure Power Rooftop One Pvt Ltd, New Delhi free of cost with free operation and maintenance for 25 years. The solar power units generated are charged at the rate of INR 3.32 per kWh of solar power generated. 1.48 MW capacity is the maximum capacity allowed to be installed in the campus following the norms of PSPCL depending upon the connected load.

Table 7: Solar Power Plant Locations and Capacity at GNDU

Roof Top Location/Department Building)	Capacity (kWp)
Administrative Block	100
Bhai Gurdas Library	100
Bhai Gurdas Library	100
Planning and Architecture	100
Guru Nanak Bhavan	100
Chemistry Department	50
Chemistry Department	25
School of Financial Studies(Old Building) in MRS Building	25
Education Department(Old)	40
Social Science (Asia House)	50
Physics Department	50
Food Science Department	50
Botanical and Environment Science	50
Biology Department	50
Girls' Hostel	65
Boys' Hostel-3	25
Lifelong Learning Department	50
New Lecture Theatres Complex	50
Electronics Department (old Building)	100
Electronics Department (old Building)	20
Zoravar Boys' Hostel	45
Sociology and Economics(Arts Block)	65
Sports and Medicine (MYAS)	50
University Business School	70
Physiotherapy	25
Maths (Old Building)	25
Total Capacity	1480

The solar power consumption is helpful in reducing the CO_2 emission. As per the data available on internet, 1 MW solar power plant offsets about 730 tons of CO_2 emission per year. Therefore, GNDU is expected to lower about 1080.4 tons of CO_2 emission per year. The solar panels also act as shades on the rooftop and help in lowering the temperature of top floor which further results in energy saving. Figures 6 depicts the installation of solar power plants on the 23 building rooftops. On the rooftops of Bhai Gurdas Library, Chemistry Department and Electronics Department (Old Building) total 6 solar plants (two per building) have been installed. Other 20 plants are installed on 20 buildings of the university, as listed in table 7. Figure 8 depicts the solar plants being installed on the rooftops of the buildings of the university.

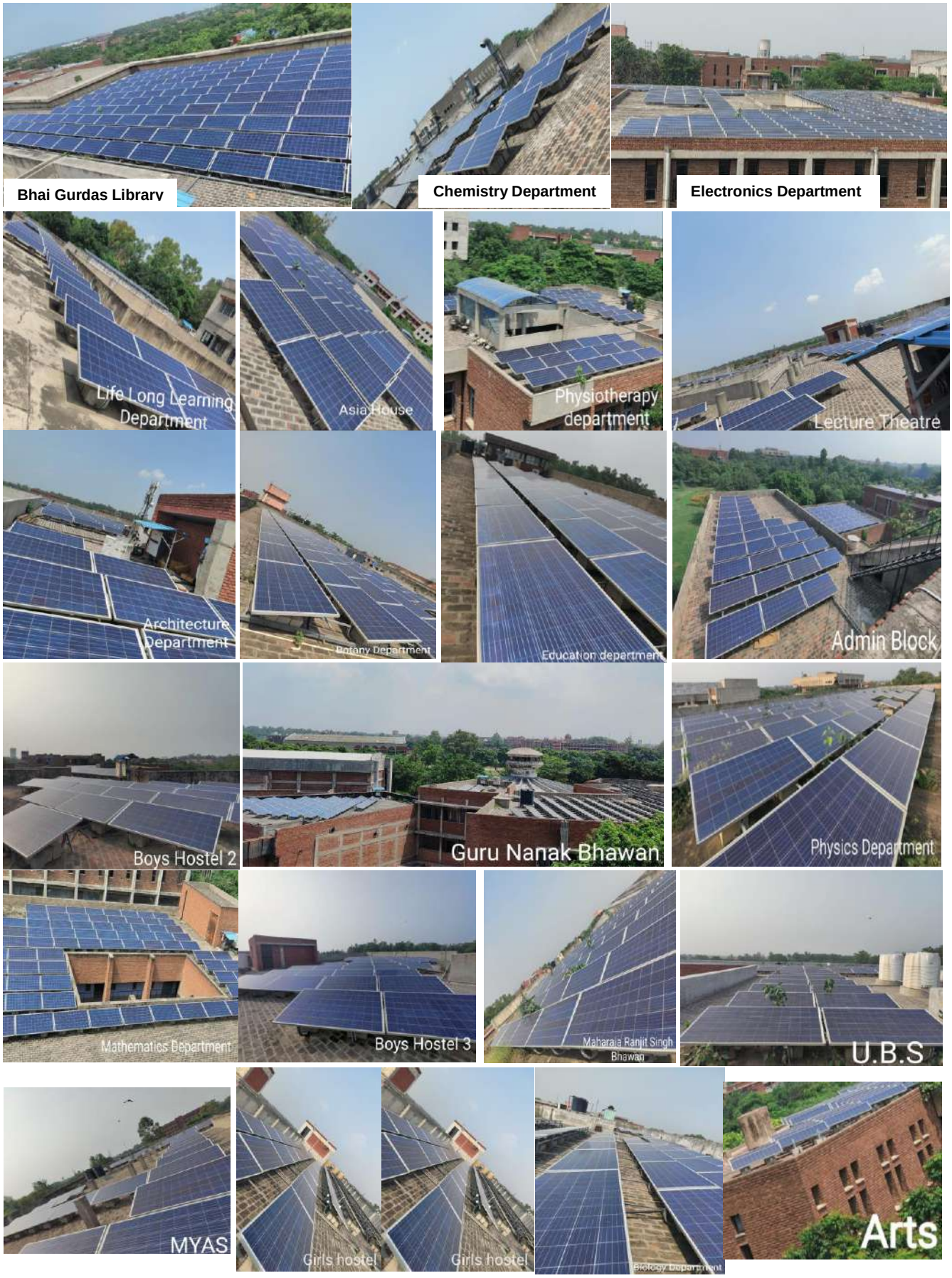


Figure 6: Installation of Solar Power Plants on the Rooftops of Buildings

3.2. Installing Energy Efficient LED Light Sources

The detail of street lights in the university is given in table 8. In the university campus there are 785 street lights. Majority of the lights have been converted into more efficient LED lights for lowering the energy consumption. Out of the 785 street light, 505 have already been replaced with more efficient LED lights. This has resulted into energy saving of almost (47925+20805+21845+4106)/2=47,340 kWh annually (refer table 8).

Table 8: Street Lights Details

Types of Street Lights	Number	Wattage	Running Hours for 12 Months	Energy Consumption for 12 Months (kWh)	Remarks
LED Pole Mounted	202	60W/70W	3650	47925	Sodium lamps of 150W has be placed with LED lamps 60W
LED Pole Mounted	95	60W	3650	20805	New Installed
LED Pole Mounted	133	45W	3650	21845	New Installed and replaced the older one.
LED Pole Mounted	45	25W	3650	4106	Replaced 40W fluorescent tube lights
Sodium Lamps Pole Mounted	220	70W	3650	56210	Old Fittings
Fluorescent Tube Lights	60	40W	3650	8760	Old fittings
Total	**755**			**1,59,651**	

Figure 7 is clearly shows that 35% of the total energy consumptions of the street light is due to sodium lamps. This energy consumption can be brought down by replacing sodium lamps with the LED Sources. Further by replacing 220 sodium lamps and 60 FTLs additional (56210+8760)/2=32,185 kWh of energy can be saved annually.

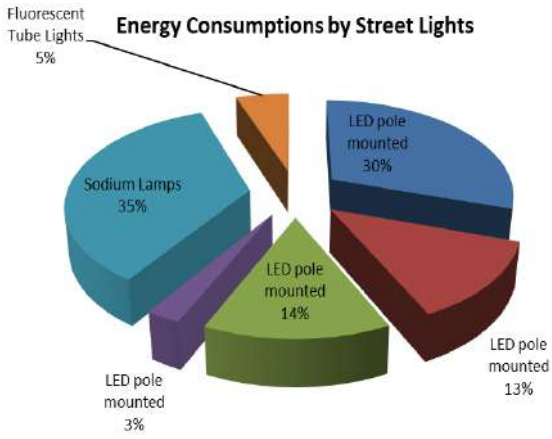


Figure 7: Energy Consumption of Street Lights

Further by replacing 220 sodium lamps and 60 FTLs additional (56210+8760)/2=32,185 kWh of energy can be saved annually. It is assumed that the wattage of LED based street light will be almost half the wattage of the conventional light source based street lights. In addition to this in all new department building like HRD centre, UIT building, new department of Education and department of Agriculture, all the light sources are energy efficient LED light sources. Further the old worn out traditional light sources are being replaced with LED light sources in retrofitting wherever possible. As per the building light details attached, presently in the hostel buildings and department buildings about 6500 FTLs (40W) are in place. These can be replaced by more efficient LED tube lights (20W) during the course of time. This will be helpful in further saving of about 1,87,200 kWh of energy annually (considering 8 hours per day on an average use for 180 working days). Figure 8 shows some photographs of energy efficient LED light sources as street lights and room lights in buildings. Extensive use of these energy efficient light sources is helpful in bringing down the energy consumption.

Figure 8: LED Light Sources for Street Lights and Room Luminaries

3.3. Use of Timer Switches for Street Lights

For additional energy saving, timer switches have been installed to switch on and off the street lights. Total 10 street light timers have been installed at suitable locations to control the on and off timing of 785 street lights in the campus. Figure 9 shows one such programmable timer switch. Different 'on' timings are programmed during the winter and summer days.

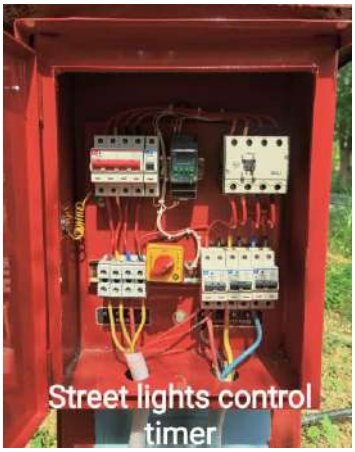


Figure 9: Timer Switches for controlling the 'On' duration of Street Lights

3.4. Use of Solar Water Heaters

Solar water heaters for the total capacity of 25600 litres have been installed in the boys and girls hostels of the university as per the detail given below in table 9. In electric heaters, for heating 20 litres of water approximately 1 kWh energy is used. The above mentioned heaters work in their full capacity for at least five months in winters. This leads to saving of approximately (25600/20) x 150= 1,92,000 kWh of conventional energy. Solar water heaters are installed on the rooftops of the hotels.

Table 9: Location and Capacity of Solar Water Heaters

Sr. No.	Location	Capacity (Litres)
1	Boys' Hostel-1	6500
2	Boys' Hostle-2	3500
3	Girls' Hostle-1	3500
4	Girls' Hostle-2	6100
5	Girls' Hostle-3	6000
	Total	**25600**

3.5. Energy Efficient Buildings

The university is very well planned campus to serve the sustainable needs of the students, staff and residents. All its buildings meet the energy efficient design standards as majority of them are placed in the best orientation for better energy efficiency and effective ventilation.

While designing the buildings, appropriate window-wall ratio is kept to maximise the use of natural light and minimise the use of light sources during day time inside the buildings, which leads to lot of energy saving. Also, most of its buildings are designed with central court yard for better light and ventilation, thus reducing the energy requirement in the buildings. Figure 10 depicts some of the university's energy efficient structures.

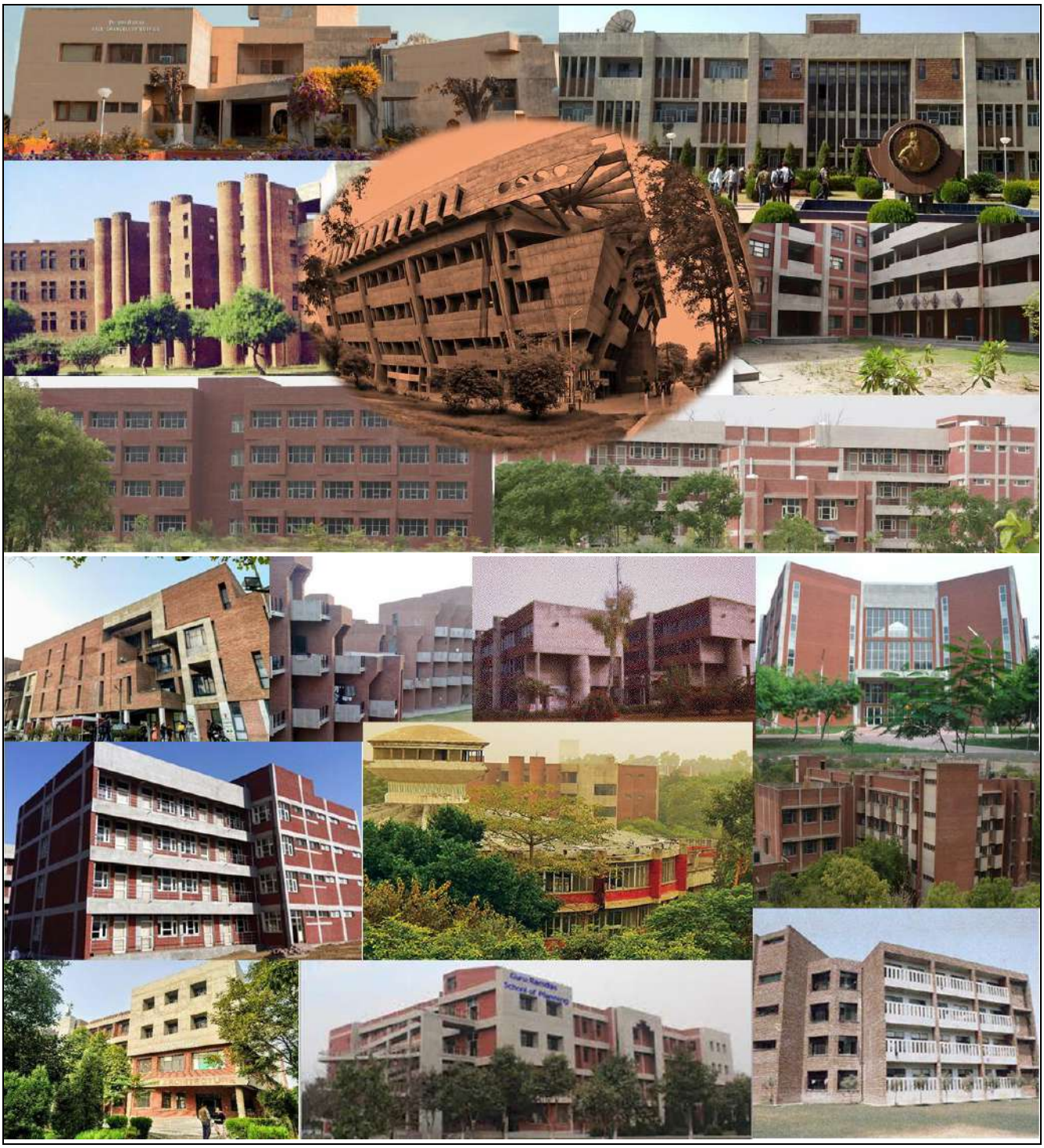


Figure 10: Energy Efficient Structures of GNDU

Disadvantage of some of the buildings from orientation point of view has been taken care of by planting trees and thick green foliage for providing protection from direct sun light. Sun breaker structures have also been incorporated in the building structures to minimise the heat penetration.

4. MINIMISING THE CONSUMPTION OF FOSSIL FUEL

University is committed to reduce the consumption of high speed diesel (HSD) and liquid petroleum gas (LPG). Following initiatives have been taken.

4.1. Operating Electric Buses

With an objective to facilitate the students, staff and the visitors to the university, 8 eco-friendly electric carts have been introduced to meet the micro mobility requirements within the campus (refer figure 11). Each bus is powered by a bank of 12, 6V batteries (72 V system). Current capacity of the battery is 225 Ah. Considering charging current equal to 15% of the current capacity, the energy consumed for charging one such bank for one hour is 33 x 72 = 2376. Taking into account the power factor of 0.9, approximately 2 kWh energy is required for charging this battery bank for one hour. Estimated energy consumption per year for charging 8 buses, for average 4 hours per day for 180 days comes out to be 2x4x8x180 = 11,520 kWh. Though the use of electric carts leads to electricity load for charging the batteries. But this much energy consumption is easily offset by the saving in high speed diesel.

Figure 11: Electric Bus for the Convenience of Students, Staff and Visitors

4.2. Rationing of Power Generation using Diesel Generator Sets

Total 4 diesel generator sets are installed in the campus as emergency back up to meet the power requirement in case of power cut from PSPCL. Two Generator sets are of 500 kVA capacity each and two of 380 kVA capacity each (refer annexure - VI).

Figure 12: Diesel Generator Sets

Fuel consumption is lowered by rationing the DG power supply to the departments during the power cuts. Table 10 clearly shows the reduction in the consumption of HSD from 27835 litre per year in 2017-2018 to 12965 litre per year in 2019-2020, a reduction by about 53 percent.

Table 10: Generator Sets Details

Ratings of DG SETS	**Number of DG Sets**		
500kVA	2		
380kVA	2		
Total No. DG Sets	HSD Consumption (Litre/Year) 2017-18	HSD Consumption (Litre /Year) 2018-19	HSD Consumption (Litre /Year) 2019-20
4	27835	17450	12965

4.3. LPG Consumption

LPG cylinders are used in the messes of the girls and boys hostel messes and canteens of the university. Total consumption of LGP is approximately 6000 cylinders (on average) annually. The details of the same are shown in annexure - VII. With an objective to reduce the consumption of LPG, alternative means such as Bio-Gas Plants and or Solar Boiler Cooking Systems are also being explored.

5. OVERALL ENERGY SAVING SCENERIO

Overall, the university is able to save about 17.39 lakh kWh per year by adopting green energy production and energy conservation strategies. Table 11 describes the actual saving on energy consumption annually. The major contribution (86.24 percent) being from 1.48 MW solar power plants, followed by solar water heaters (11.04 percent) installed in the hostels of the university. LED street lights save conventional energy to the tune of 2.72 percent.

Table11: Annual Energy Saving

Means	**Annual Saving in kWh**	**Percentage Contribution**
1.48 MW Solar Power Plants	15,00,000	86.24
LED Street Lights	47,340	2.72
Solar Water Heating	1,92,000	11.04
Total	17,39,340	100.00

6. CARBON FOOTPRINTS REDUCTIONS BY GNDU

Fruitful efforts have been made to reduce the conventional electricity consumption which further leads to reduction in university's contribution to the carbon footprints. Saving of 10,00,000 kWh energy results into 730 tons of less CO_2 emission. As such 17,39,340 will result into 1270 tons of less CO_2 emission. Saving of 10,00,000 kWh of energy is equivalent to planting 33183 fully grown trees to absorb the equivalent CO_2 emission. As such the university has contributed towards planting of 57,717 fully grown trees annually in terms of annual energy saving. In addition to this the university has potential to further reduce the annual energy consumption as explained in the table 12.

Table 12: Potential for Further Reduction of Annual Energy Consumption by the University

Means	Annual Saving in kWh
Replacing the existing 1.5 Ton capacity ACs with 20% more efficient ACs	2,34,511
Replacing 6500 TFTs with power efficient LED lights	1,87,200
Replacing existing Sodium Lamps and FTL based street lights	32,185
Using Solar Powered sheds for charging stations for E-Buses	11,520
Total Saving	**4,65,416**

This will result into additional reduction in CO_2 emission by 340 tons annually and equivalent to planting 15,430 fully grown trees annually.

In addition to the above mentioned saving in the consumption of conventional electricity energy, saving of HSD has also been achieved. E-Buses save around 14,400 Lts of HSD annually. Every bus travels around 50-60 km daily inside campus. In case of diesel powered bus this will lead to 10 Lts HSD consumption plus pollution. Eight E-Buses used for the whole year for at least 180 working days lead to saving of 180x80=14,400 Lts of HSD in 2019-2020 in comparison to that in 2017-2018. Rationing of diesel generator power has also resulted into around 55 percent less consumption of HSD. This is a considerable contribution towards lowering of carbon foot prints.

By implementing Bio-Gas plants and/or solar boiler based cooking the consumption of LPG gas can be reduced from current 6000 LPG cylinder to almost zero.

7. RECOMMENDATIONS

For reducing the energy consumption further, the following recommendations will be useful.

1. Replacing the exiting Fluorescent tube lights and other filament based light sources with the more energy efficient LED light sources either in new fittings or in the retro fittings wherever possible. This can be achieved in a phased manner to match life cycle completion of the older lighting systems.

2. Smart meters can be implemented at all the departments to keep a check on consumption and to study the trend of consumption over the period of full year. This will be helpful in suggesting methods for lowering the energy consumption.

3. Sensor systems can be installed in the class rooms and laboratories to switch off the electrical appliance when nobody is present in the rooms.

4. Sensors can also be used in corridors to switch on and off the lights on the need base.

5. For charging E-Buses, standalone solar power based charging station can be developed.

6. The university campus is well planned. Only a few buildings are west and south facing. By planting large trees and growing green foliage cover on the west and south of the buildings, the energy consumption can be further reduced.

7. By replacing the older worn out cooling equipment with the latest more power efficient cooling equipment having better BEE rating.

8. Water cooled or Air cooled HVAC systems can also be explored to replace the traditional air conditioning.

9. Designing / renovating the buildings with better cross ventilation and less heat absorption by utilising heat reflecting tiles on building roofs and films on window pans.

10. LPG consumption can be lowered by installing biogas plants and solar boilers for cooking in hostels.

8. CONCLUSIONS

Since its establishment, Guru Nanak Dev University has remained a role model in different fields, be it research in sciences, life sciences, humanities or any professional discipline. By practicing its research and applying the innovative mechanisms in the energy sector with an objective to play its pro-active role in reducing the consumption of conventional energy, the university has emerged as one of the few higher education institutions in the region to have contributed to production of green energy (solar energy) and lessening its contribution to the carbon footprints. Its commitment to further contribute towards reduced consumption of conventional energy and promoting green energy sources will make it expert institution to guide the others in energy conservation practices in the near future.

****

Annexure - I

Consumption of Electricity for last Four Years

Month	Units Consumed for connection No.(1) A25GC3300067	Units Consumed for connection No.-(2) A25GC3300068	Total
May-17	471280.00	283668.00	754948.00
June-17	376560.00	233796.00	610356.00
July-17	429800.00	286704.00	716504.00
August-17	497000.00	327210.00	824210.00
September-17	462080.00	283284.00	745364.00
October-17	417120.00	229722.00	646842.00
November-17	326640.00	171534.00	498174.00
December-17	317960.00	188004.00	505964.00
January-18	361440.00	193752.00	555192.00
February-18	289560.00	204558.00	494118.00
March-18	307320.00	205152.00	512472.00
April-18	393080.00	230772.00	623852.00
May-18	512960.00	256188.00	769148.00
June-18	432160.00	206520.00	638680.00
July-18	0.00	263094.00	263094.00
August-18	1005640.00	341190.00	1346830.00
September-18	486880.00	248466.00	735346.00
October-18	377560.00	197820.00	575380.00
November-18	298160.00	163428.00	461588.00
December-18	298760.00	188232.00	486992.00
January-19	339400.00	233334.00	572734.00
February-19	291440.00	201090.00	492530.00
March-19	264920.00	212976.00	477896.00
April-19	367520.00	0.00	367520.00
May-19	456400.00	0.00	456400.00
June-19	333640.00	0.00	333640.00
July-19	168840.00	0.00	168840.00

August-19	0.00	366390.00	366390.00
September-19	0.00	0.00	0.00
October-19	764240.00	1016070.00	1780310.00
November-19	0.00	0.00	0.00
December-19	0.00	0.00	0.00
January-20	0.00	0.00	0.00
February-20	755680.00	768882.00	1524562.00
March-20	0.00	0.00	0.00
April-20	0.00	0.00	0.00
May-20	0.00	0.00	0.00
June-20	0.00	0.00	0.00
July-20	238000.00	477558.00	715558.00
August-20	227960.00	421752.00	649712.00
September-20	270240.00	366264.00	636504.00
October-20	117160.00	155310.00	272470.00
November-20	125480.00	124212.00	249692.00
December-20	146000.00	124758.00	270758.00
January-21	171320.00	156252.00	327572.00
February-21	312760.00	271608.00	584368.00
March-21	228000.00	153246.00	381246.00
April-21	199480.00	129786.00	329266.00
Total	**13840440.00**	**9882582.00**	**23723022.00** Units

Incharge Div I & IV(E)
GNDU
Amritsar

29/4/21

Annexure - II

original

सोलर एनर्जी कॉर्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उपक्रम)
Solar Energy Corporation of India Ltd.
(A Government of India Enterprise)
स्वच्छ भारत – स्वच्छ ऊर्जा

Ref. No.: SECI/C&P/MNRE/1000MW RT/IND/122016/NOA/ 1583
Date: 12.09.2017

Azure Power Rooftop One Pvt. Limited
8, Local Shopping Complex
Pushp Vihar, Madangir
New Delhi - 110 062

Attn: Mr. Gaurang Sethi (Head - Business Development)

Sub.: Letter of Allocation (LOA) as Successful Bidder/ Developer for Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX and/ or RESCO Model (PHASE - I) against RfS No.: SECI/C&P/MNRE/1000MW RT/IND/122016

Dear Sir,

1.0 REFERENCE

This has reference to the following:

1.1 Our Invitation for Bids (IFB) dated 09.12.2016

1.2 Bidding documents for the subject package issued vide our NIT Ref. No. SECI/C&P /MNRE/1000MW RT/IND/122016 dated 09.12.2016

1.2.1 Amendments to Bidding Documents issued vide our Amendment no. I dated 29.12.2016, Amendment no. II dated 20.01.2017, Amendment no. III dated 14.04.2017, Amendment no. IV dated 21.04.2017 and Amendment no. V dated 26.04.2017

1.2.2 Clarifications to the Bidding Documents, pursuant to pre-bid conference held on 10.01.2017, issued vide our clarifications dated 20.01.2017

1.3 First envelope of the Bid submitted by the bidder for the subject package and was opened on 15.05.2017

1.4 Second Envelope of the Bid by the bidder for the subject package and was opened on 21.07.2017

1.5 Consent for matching with L-1 Price

2.0 AWARD OF CONTRACT AND ITS SCOPE

2.1 We confirm having accepted bid of the successful bidder/ developer (referred to at para 1.3 & 1.4 above) read in conjunction with all the specifications, terms & conditions of the bidding documents (referred to at para 1.2, 1.2.1 & 1.2.2) and specific consent offered (referred to at para 1.5 above), and award on the successful bidder/ developer the 'Contract' (also referred to as the "Project" or "Scheme") for performance of all activities, as set forth in the documents, viz. Implementation of 1000MW Grid Connected Roof Top

Regd. Office : D-3, 1st floor, Wing-A, Religare Building, District Center, Saket, New Delhi - 110017
Phone : (011) 71989200, Email : corporate@seci.gov.in, Website : www.seci.gov.in
CIN : U40106DL2011GOI225263

State	CAPEX (Part-A)		RESCO (Part-B)	
	Capacity (in kWp)	Project Cost/kWp (in INR)	Capacity (in kWp)	Tariff/kWh (in INR)
Uttar Pradesh	NIL	Not Applicable	10946.300	3.910
West Bengal	NIL	Not Applicable	5502.870	3.620
GRAND TOTAL	**NIL**		**50000.000**	

3.2 The details of the levelized tariff (for Kerala) is enclosed at Annexure-I to this LOA. The details of the levelized tariff for other allocated states/ UTs (duly stamped and signed) of 25 years under RESCO (Part - B) shall be furnished by you within 30 (Thirty) days from the date of issuance of this LOA. The same should be in the prescribed format attached at Annexure-I and final value shall not exceed the L-1 price of the allocated state/ UT/ Island.

3.3 The benchmark cost of Ministry of New and Renewable Energy (MNRE) is as mentioned below: -

For Projects having size of 1 kWp to 10 kWp : INR 70,000/- per kWp
For Projects having size of 10.1 kWp to 100 kWp : INR 65,000/- per kWp
For Projects having size of 100.1 kWp to 500 kWp : INR 60,000/- per kWp

The total outgo (i.e. sum of indicated Project Cost in the table under clause no. 3.1 of this LOA Plus Incentive against each State/ UT/ Island) shall not exceed the benchmark cost of MNRE mentioned above under clause no. 3.3.

3.4 The incentive structure applicable is tabulated below: -

Sl. No.	Achievment vis-à-vis Target Allocation	Incentives for General Category States/ UTs	Incentives for Special Category States/ UTs/ Islands
1	80% and above within the sanctioned period	INR 16,250/- per kW	INR 39,000/- per kW
2	Below 80% and above 50% (including 50%) within the sanctioned period	INR 9,750/- per kW	INR 23,400/- per kW
3	Below 50% and above 40% (including 40%) within the sanctioned period	INR 6,500/- per kW	INR 15,600/- per kW
4	Below 40% within the sanctioned period	NIL	NIL

Special Category States/ UTs/ Islands include - North Eastern States including Sikkim, Uttarakhand, Himachal Pradesh, Jammu & Kashmir, Andaman & Nicobar Islands and Lakshadweep Islands

The incentives indicated above are subject to revision on Annual basis and shall be read in conjunction with clause nos. 3.5 and 3.6.

3.5 Incase of CAPEX Mode, the incentives mentioned in the table under clause no. 3.3 of LOA shall be limited to

3.5.1 For Sr. No. 01 (INR 16,250/- per kW for general category states/ UTs and INR 39,000/- per kW for special category states/ UTs/ Islands) upto 25% of the benchmark cost or the cost of allocated state mentioned under clause no. 3.1, whichever is lower, for general category states/ UTs and upto 60% of the benchmark cost or the cost of allocated state mentioned under clause no. 3.1, whichever is lower, for special category states/ UTs/ Islands.

3.5.2 For Sr. No. 02 (INR 9,750/- per kW for general category states/ UTs and INR 23,400/- per kW for special category states/ UTs/ Islands) upto 15% of the benchmark cost or the cost of allocated state mentioned under clause no. 3.1, whichever is lower, for general category states/ UTs and upto 36% of the benchmark cost or the cost of allocated state mentioned under clause no. 3.1, whichever is lower, for special category states/ UTs/ Islands.

3.5.3 For Sr. No. 03 (INR 6,500/- per kW for general category states/ UTs and INR 15,600/- per kW for special category states/ UTs/ Islands) upto 10% of the benchmark cost or the cost of allocated state mentioned under clause no. 3.1, whichever is lower, for general category states/ UTs and upto 24% of the benchmark cost or the cost of allocated state mentioned under clause no. 3.1, whichever is lower, for special category states/ UTs/ Islands.

3.6 Incase of RESCO Mode, the incentive amount for general category states/ UTs will be upto 25% of the benchmark cost as mentioned under Clause no. 3.3 of this LOA. The benefit of the incentives should be passed on to the customer in the form of reduced tariff by factoring incentive. In case of special category states/ UTs/ Islands the applicable incentives will be upto 60% of the benchmark cost as mentioned under Clause no. 3.3 of this LOA.

4.0 DISBURSEMENT OF INCENTIVE

The incentive shall be disbursed as follows

The incentive shall be released after commissioning of the project and submission of Project Commissioning Reports (PCRs) in SPIN portal at the end of sanction period and submission of original audited Statement of Expenditure (SOE). The successful bidder/ developer will also make the sites/ premises available for inspection by MNRE/ SECI or its designated team/ agency. Minimum 40% of the sanctioned capacity has to be installed in order to avail incentives.

The First Lot of the applicable incentive amount (2/3 of the amount) shall be released against successful demonstration of the desired PR of 75% against commissioning. The Second Lot of the applicable incentive amount (1/3 of the amount) shall be released against successful demonstration of the desired CUF of 15% for general category states/ UTs and 13.5% for special category states/ UTs/ Islands against completion of first year of successful O & M. In case of non-achievement of above mentioned 02 different milestones (first at commissioning and second at first year of O & M), no incentive shall be disbursed. However, SECI may extend an option to developer(s) for re-demonstration of performance parameters after due rectification at its sole discretion.

SECI may consider to release incentive on case to case basis depending on the actions taken by the successful bidder/ developer and subject to meeting the following conditions:

- The rooftop SPV power plant should be completed as per the scope of RfS.
- The rooftop SPV power plant must get CEIG inspection certificate.
- Intimation to the concerned DISCOM : All the developers shall intimate the concerned DISCOMS regarding implementation of grid connected roof top solar PV projects as per the given format in Annexure-M of RfS and submit the copy of same to SECI for the purpose of release of Incentive.
- Owner Consent : In case the successful bidder/ developer is not the Owner of the Project, subsidy shall be released to successful bidder/ project developer after written consent of roof top owner only. For RESCO projects, owner shall be the successful bidder/ developer.

5.0 PERFORMANCE SECURITY

The successful bidder/ developer is required to furnish at the earliest but not later than 30 days from the date of issuance of this Letter of Allocation the Performance Security(ies), as per the bidding documents, for an amount of as described below: -

For general category states/ UTs:
PBG amount = (INR 16.25 Lakh) X Allocated Capacity in MWp in a State.

For special category states/ UTs/ Islands:
PBG amount = (INR 39.00 Lakh) X Allocated Capacity in MWp in a State

The Performance Securities shall be submitted separately for all the States. Part Performance Security shall not be accepted.

Any delay in submission of Performance Security beyond 30 (Thirty) days shall attract interest @ 1.25 % per month on the total amount, calculated on day to day basis. SECI at its sole discretion may cancel the allocated capacity and forfeit 100% of Bid Bond/ EMD, in case the requisite Performance security is not submitted within 60 days from issuance of Letter of Allocation.

The Performance Security shall be valid for a minimum period of 5 (Five) years from the date of issuance of Letter of Allocation and shall be renewed/ extended till the completion of 5 years of O & M period. The Performance Security shall be released after 5 years from the date of commissioning with the compliance of entire obligations in the contract

In case, due to delay, Performance Security submitted by the successful bidder/ developer is forfeited in full/ part, the successful bidder/ developer has to resubmit the Performance Security of requisite amount and validity as per the RfS, failing which their Incentive amount shall not be released.

The Performance Security shall be submitted in the form of bank guarantee in requisite format from an eligible bank as described in the RfS documents.

6.0 SCHEDULE FOR COMPLETION OF PROJECT/ SANCTION PERIOD

The schedule for completion of project shall be **30.06.2018 for general category states/ UTs** and **30.09.2018 for special category states/ UTs/ Islands** for all contractual purposes.

If the successful bidder/ developer fails to commission the sanctioned project within specified time i.e. on or before 30.06.2018/ 30.09.2018, as the case may be, no incentive shall be disbursed. However, further period of 06 (Six) months shall be allowed to successful bidder/ developer for completion of entire unexecuted allocated capacity and penalty/ LD on per day basis calculated for the Performance Security on a 06 (Six) months period would be levied. After 06 months [i.e. after 30.12.2018/ 30.03.2019, as the case may be], the entire project will get cancelled and the total PBG would be forfeited.

7.0 INITIAL ALLOCATION OF BUILDINGS

For facilitating successful bidder/ developer, a list of Government Buildings/ Institutions indicating location/ address/ tentative roof top size/ approximate capacity potential etc. is enclosed at Annexure-II. Initially SECI will allocate buildings/ capacities as per the clause no. 1.5.3 (Allocation of Capacity) of the original RfS documents including its amendment.

The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly, the indicative Solar Roof Top Potential may also vary.

The list is purely indicative. This indicative list has been prepared (by an agency after assessment) along with the building addresses and the states which it belongs to. Based on the above, the initial allocation has been made as per methodology stipulated in original tender documents including its amendments and clarifications. Though due care has been taken in such allocation, successful bidders/ developers are requested to ascertain the buildings, feasibility of space including their capacities allocated to them and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI. In case of any discrepancies in initial allocation of buildings/ capacities, bidders are requested to factor in those discrepancies prior to giving acceptance of LOA. The final installation capacity shall be sanctioned by SECI based on submission of Project Sanction Documents to SECI.

All the buildings having proposed installation capacity of less than and including 105 kWp shall be allocated under CAPEX Model initially based on assumption Only. Similarly, all the buildings having proposed installation capacity of more than 105 kWp shall be allocated under RESCO Model initially based on assumption only.

The initial allocation of buildings shall be indicative and valid for 30 (Thirty) days only from the date of issuance of Letter of Allocation. The bidders may submit their consent/ project sanction documents to SECI during this initial 30 (Thirty) days for the allocated buildings. After 30 (Thirty) days from LOA, any successful bidder/ developer shall be allowed to execute the Project on the allocated building(s) for which no consent/ project sanction documents are received by SECI. Final sanction shall be accorded by SECI to those successful bidder/ developer who will come with sanction documents on "First Come" basis

7.1 Any successful bidder/ developer, who do not wish to adopt the initially allocated buildings by SECI, shall submit their consent preferably within 30 (Thirty) days from the date of issuance of Letter of Allocation. Alternatively, those successful bidder/ developer may bring his own proposal related to Central/ State government buildings on the allocated state/ any other state. Similar proposal may be considered by SECI on its own discretion and subject to approval by Competent Authority. In case the proposal of successful bidder/ developer corresponds to any other state, the lowest L-1 Price between both the states (i.e. Allocated Vs. Proposed) shall prevail.

7.2 The successful bidder/ developer needs to contact and obtain the consent from building owner immediately. In case the building owner does not agree for installation under allocated model (either CAPEX/ RESCO), successful bidder/ developer need to intimate such case along with consent from building owner in writing preferably within 30 (Thirty) days from the date of issuance of Letter of Allocation. In case the building owner does not agree for the allocated model (either CAPEX/ RESCO), the successful bidder/ developer will have an option to execute the allocated capacity on the desired model (either CAPEX/ RESCO) of the building owner by matching the L-1 Price of the desired model corresponding to that particular state. A written request duly approved by the building owner shall be submitted to SECI for reference, records and further necessary actions.

7.3 In case the successful bidder/ developer does not want to execute the allocated capacity as mentioned above under clause no. 7.2, SECI will re-allocate alternative buildings on the quoted model of the successful bidder/ developer either in same state or in different state subject to availability and upon successful bidder's/ developer's consent. In this case the lowest L-1 Price of both the states shall prevail.

7.4 Incase SECI will not able to re-allocate alternative buildings, the successful bidder/ developer may come up with its own proposal related to any Central/ State government buildings either on the allocated state or in different state. The desired model (either CAPEX/ RESCO) shall be clearly written and duly approved by the building owner on the said alternative proposal. The alternative proposal may be considered by SECI on its own discretion and subject to approval by Competent Authority. In this case the lowest L-1 price of both the states shall prevail.

7.5 In case of non-availability of alternative roof tops, the successful bidder/ developer shall have an option for Interstate Transfer of Capacities as per clause no. 1.7.2 of the RfS documents subject to availability. In this case the lowest L-1 price of both the states shall prevail.

7.6 In case of non-fulfilment of any of the conditions mentioned above under Clause no. 7 maximum within 30.06.2018 for general category states/ UTs or 30.09.2018 for special category states/ UTs/ Islands, the PBG for the unexecuted capacity(ies) shall be forfeited at the sole discretion of SECI.

7.7 In case the successful bidder/ developer opts for any of the options indicated above under clause nos. 7.2, 7.3, 7.4 or 7.5, the amended Performance security (PBG pertaining to additional capacity allocated or capacity transferred) shall be submitted within 15 (Fifteen) days from the date of issuance of such notification in line with clause no. 1.7.3, Page 38 of original RfS documents. Similarly, in case of decrease in revised allocated capacity with respect to that of original allocated capacity, Performance Security of respective decreased capacity shall be released by SECI without any interest charges.

8.0 SANCTION OF PROJECT

After submission of project sanction documents by the successful bidder/ developer and accepted by SECI, SECI will issue the sanction letter(s) for the project(s) indicating the incentive amount(s) which will be disbursed in line with the provisions of the RfS document including its amendment(s). The successful bidder/ developer shall complete the entire scope of the work within 30.06.2018/ 30.09.2018, as the case may be.

9.0 SERVICE CHARGES OF SECI

In both general category states/ UTs and special category states/ UTs/ Islands, service charges of SECI shall be computed as 5% of the [Quoted Project Cost/ MNRE benchmark cost, whichever is lower, minus incentives].

The above charges are exclusive of Goods and Service Tax (GST) which shall be paid extra as per applicable norms.

As the service charges of SECI shall be collected at the time of submission of project sanction documents i.e. prior to execution of the project, the amount of incentive to be disbursed can't be computed at that point of time. Hence the Service/ PMC Charges of SECI shall be computed as 5% of the [Quoted Project Cost/ MNRE benchmark cost, whichever is lower]. However, after disbursement of incentive, a proportionate adjustment may be done at the sole discretion of SECI and refund shall be made if any.

10.0 LIQUIDATED DAMAGES

If the successful bidder/ developer fails to commission the sanctioned project within specified time, Liquidated Damages on per day basis calculated for the Performance Security on a 06 (Six) months period would be levied. After 06 (Six) months the project will get cancelled and the total Performance Security amount would be forfeited.

10.1 If a project of 1 MWp in general category state/ UT is delayed by 36 days then the Liquidated Damages will be levied as given below

Liquidated Damages = [(Performance Security)/180 Days] * delayed days = (1,625,000/180) * 36 = INR 325,000/-

10.2 If a project of 1 MWp in special category state is delayed by 36 days then the Liquidated Damages will be levied as given below

Liquidated Damages = [(Performance Security)/180 Days] * delayed days = (3,900,000/180) * 36 = INR 780,000/-

11.0 This Letter of Allocation constitutes formation of the Contract and comes into force with effect from the date of issuance of this Letter of Allocation.

12.0 All other terms and conditions including technical specifications and details shall be as per the bidding documents (referred to at para 1.2, 1.2.1 & 1.2.2, Page 01 of this LOA).

13.0 PROJECT MANAGER/ ENGINEER-IN-CHARGE

The authorized Project Manager/ Engineer-in-Charge for implementation of the Project on behalf of SECI is mentioned below: -

Shri Rajesh Kumar Jain (Addl. General Manager - Solar)

Solar Energy Corporation of India Limited
D - 3, 1st Floor, Wing - A, Religare Building
District Center, Saket
New Delhi - 110 017
Phone : 0091 (11) 71989211 Fax : 0091 (11) 71989243
E-mail : agmsolar@seci.co.in

All future correspondence shall be addressed to the authorized Project Manager/ Engineer-in-Charge as mentioned above.

14.0 This Letter of Allocation is being issued to you in duplicate. We request you to return its duplicate copy duly signed and stamped on each page including the enclosed Annexure as a token of your acknowledgement within 30 (Thirty) days from the date of its issuance.

Please take the necessary action to commence the work and confirm action.

Yours faithfully,

For and on behalf of

Solar Energy Corporation of India Limited

Manas Ranjan Mishra
12.09.2017

Manas Ranjan Mishra
Manager (Contracts & Procurement)

मानस रंजन मिश्रा / Manas Ranjan Mishra
प्रबन्धक (संविदा एवं खरीद) / Manager (Contracts & Procurement)
सौर ऊर्जा निगम भारत लि. / Solar Energy Corp. of India Ltd.
(भारत सरकार का उद्यम) / (A Govt. of India Enterprise)
डी-3,प्रथम तल, 'ए' विंग, डिस्ट्रिक्ट सेन्टर, साकेत, नई दिल्ली-17
D-3, 1st Floor, 'A' Wing, District Centre, Saket, New Delhi-110017

Enclosures:

ANNEXURE - I - Details of Levelized Tariff/ Format for Levelized Tariff
ANNEXURE - II - List of Initial Allocated Buildings

Annexure-I

Azure Power®

NIT No. SECI/C&P/MNRE/1000MW RT/IND/122016

Format For Price Schedule

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in States

PRICE BID for RESCO (For Projects Ranging From 2 MWp to 50 MWp) - MAIN BID

General Category State of India - Kerala (2892.600 KWp) Main

Sl. No.	Year of Operation	Tariff (INR / kWh)	Discount Factor @ 11%	Discounted Tariff (INR / kWh)
1	2	3	4	6 = 3 * 4
1	1st Year (First Year)	3.97	1.000	3.97
2	2nd Year (Second Year)	3.97	0.901	3.57697
3	3rd Year (Third Year)	3.97	0.812	3.22364
4	4th Year (Fourth Year)	3.97	0.731	2.90207
5	5th Year (Fifth Year)	3.97	0.659	2.61623
6	6th Year (Sixth Year)	3.97	0.593	2.35421
7	7th Year (Seventh Year)	3.97	0.535	2.12395
8	8th Year (Eighth Year)	3.97	0.482	1.91354
9	9th Year (Ninth Year)	3.97	0.434	1.72298
10	10th Year (Tenth Year)	3.97	0.391	1.55227
11	11th Year (Eleventh Year)	3.97	0.352	1.39744
12	12th Year (Twelveth Year)	3.97	0.317	1.25849
13	13th Year (Thirteenth Year)	3.97	0.286	1.13542
14	14th Year (Forteenth Year)	3.97	0.258	1.02426
15	15th Year (Fifteenth Year)	3.97	0.232	0.92104
16	16th Year (Sixteenth Year)	3.97	0.209	0.82973
17	17th Year (Seventeenth Year)	3.97	0.188	0.74636
18	18th Year (Eighteenth Year)	3.97	0.170	0.6749
19	19th Year (Nineteenth Year)	3.97	0.153	0.60741
20	20th Year (Twentieth Year)	3.97	0.138	0.54786
21	21st Year (Twenty First Year)	3.97	0.124	0.49228
22	22nd Year (Twenty Second Year)	3.97	0.112	0.44464
23	23rd Year (Twenty Third Year)	3.97	0.101	0.40097
24	24th Year (Twenty Fourth Year)	3.97	0.091	0.36127
25	25th Year (Twenty Fifth Year)	3.97	0.082	0.32554
	Total	INR 37.123		
Levellized Tariff for 25 Years (in INR / kWh) = X/9.351				INR 3.97
Levellized Tariff for 25 Years in Words				Three Rupees and Ninety Seven Paise

Note-1: - In case of discrepancy in the Main Bid (Excel File) and Electronic Form, the Price mentioned in the Excel File will prevail. Also it may be noted that the applicable incentive amount shall be released directly to successful bidder / developer in Indian Rupees (INR) only.

Note - 2: - The year of operation for first year shall be calculated w.e.f. date of commercial operation to 31st March of immediately succeeding financial year.

Note - 3: - The year of operation from second year upto twenty fifth year shall be calculated w.e.f. 1st April to 31st March of immediately succeeding financial year.

a. The levellized tariff shall be calculated up to three decimal places. However in case of a tie it may be
b. Tariff stream quoted by the bidder shall be levellized with a discounting rate of 11% only.
c. Maximum allowable Levelllzed Tariff for this part is as per clause no. 2 of Amendment-V.
d. Bids not in confirmity with above provisions will be rejected

Gaurang Sethi

Date 11.05.2017
Place New Delhi
Address 8, LSC, Madangir, PushpBhavan, New Delhi-110062

Name Gaurang Sethi
Designation Authorised Signatory

AZURE POWER ROOFTOP ONE PVT. LTD. New Delhi

Azure Power Rooftop One Pvt. Ltd.
CIN U40300DL2017PTC316260
Regd. Office 8, Local Shopping Complex, Pushp Vihar, Madangir, New Delhi - 110062
Ph. : 011-49409800 Fax : 011-49409807 E-mail: bd.rooftop@azurepower.com Web: www.azurepower.com

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN CHANDIGARH

(680.130 kWp)

RESCO MODEL (INR 3.440 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Chandigarh	Ministry of Consumer Affairs, Food & Public Distribution	BIS NRO Building, Sector-27B, Madhya Marg, Chandigarh	260
2	Chandigarh	Ministry of Consumer Affairs, Food & Public Distribution	Central Warehousing Corporation, RegionalL Office- Bay No.39-42, Sec.31A, CHANDIGARH-160030	236
3	Chandigarh	MHRD	Kendriya Vidyalaya 3 BRD, Air Force Station, Near Kalibadi Mandir, Chandigarh, 160002	205
TOTAL				701

Note: The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN CHHATTISGARH (1945.080 kWp) RESCO MODEL (INR 3.220 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Chattisgarh	MHRD	Kendriya Vidyalaya No.2 Din Dayal Upaddhayay Nagar, Sector 4, Amanaka, Raipur, Chhattisgarh 492010	304
2	Chhattisgarh	Dena Bank	Bhilai, sector 10, plot No B1, Bhilai, Dist. Dur9	276
3	Chattisgarh	MHRD	Higher Education Department Govt. D.B Girls P.G. (Autonomous) College Raipur, C.G	252
4	Chattisgarh	MHRD	Kendriya Vidyalaya Chitalanka Bailadila, Dantewada District, Chitalanka, Chhattisgarh 494449	230
5	Chhattisgarh	Ministry of Culture	Sita Devi Temple & Sati Pillar, Deorbija, Tehsil-Berla, Distt. Bametara	207
6	Chhattisgarh	Ministry of Culture	Chandraditya temple & Sculpture Shed, Barsoor, Tehsil-Gidam, Distt. South Bastar Dantewada	207
7	Chhattisgarh	Ministry of Culture	Mahadev Temple & sculpture Shed, Tuman, tehsil-Padui Upora, Distt. Bilaspur	207
8	Chhattisgarh	Ministry of Culture	Brick Temple Savari, Kharod, Tehsil-Pamgarh, Distt. Janjgir Champa	207
9	Chhattisgarh	Ministry of Culture	Mahadeo Temple & Sculpture Shed, pali, Tehsil-Pali, Distt.Kobra	207
TOTAL				2096

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN DELHI (9235.890 kWp)

RESCO MODEL (INR 3.390 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Delhi	MHRD	IIT, Hauz Khas, New Delhi, Delhi 110016	1863
2	Delhi	Ministry of Agriculture	NASC Complex, Dev Prakash Shastri Marg Opp. Dasghara,, Pusa Campus, Pusa, New Delhi, Delhi 110012	696
3	Delhi	Ministry of Agriculture	ICAR-National Bureau Plant Genetic Resources, Wz-256f/7, Dev Prakash Shastri Marg, Inder Puri, New Delhi, Delhi 110012	521
4	Delhi	Ministry of Textiles	National Institute Of Fashion Technology (NIFT), Campus, Main Road, Hauz Khas, New Delhi, Delhi 110016	451
5	Delhi	Ministry of Culture	National Archives of India, Janpath Road, Opposite Indira Gandhi National Centre for the Arts, Near Shastri Bhavan, New Delhi, Delhi 110001	448
6	Delhi	MHRD	Kendriya Vidyalaya No. 3, Narayana Ring Road, Opp Nausena Bagh, Naraina, Delhi Cantonment, New Delhi, Delhi 110010	444
7	Delhi	MHRD	Shri Lal Bahadur Shastri Rashtriya Sanskrit Vidyapeetha, B-4, Qutub Institutional Area, Shaheed Jeet Singh Marg, Qutab Institutional Area, Katwaria Sarai, New Delhi, Delhi 110016	423
8	Delhi	Ministry of Textiles	Office of the Development Commissioner Handlooms, Udhyog Bhawan, Rafi Ahmed Kidwai Marg, Rajpath Road Area, Central Secretariat, Rajpath Area, Central Secretariat, New Delhi, Delhi 110011	416
9	Delhi	MHRD	Kendriya Vidyalaya, Air Force Station, Mehrauli Badarpur Road, Opp Jamia Hamdard University, Talimabad, Sangam Vihar, New Delhi, Delhi 110080	377
10	Delhi	MHRD	Kendriya Vidyalaya No - 2, Gurgaon Road, N.H. No. - 8, Near A.P.S. Colony, Delhi Cantt, New Delhi, Delhi 110010	372
11	Delhi	Ministry of Culture	Nehru Memorial Museum & Library, Teen Murti Bhawan, New Delhi, Delhi 110011	371
12	Delhi	MHRD	Kendriya Vidyalaya, AFS Ghoga Road, Bawana, North West Delhi, Delhi, 110039	354
13	Delhi	MHRD	Kendriya Vidyalaya, Near Vivek Vihar Police Station Rd Number 71, Vigyan Vihar, Surajmal Vihar, Delhi 110092, Delhi	346
14	Delhi	MHRD	Kendriya Vidyalaya No. 1, Delhi Cantonment, Near Sadar Bazar, New Delhi, Delhi 110010	345

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN DELHI (9235.890 kWp)
RESCO MODEL (INR 3.390 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
15	Delhi	Ministry of Housing and Urban Poverty Alleviation	Housing & Urban Development Corporation Ltd. (HUDCO) Under Min. Of Housing & Urban Poverty Alleviation, August Kranti Bhawan at Plot No.25, Bhikaji Cama Place,New Delhi.	345
16	Delhi	Ministry of Culture	National Science Centre, Delhi, Near Gate 1, Pragati Maidan Bhairon Road, New Delhi-110001	276
17	Delhi	Ministry of Minority Affairs	Ministry of Minority Affairs, 11th Floor, Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi, Delhi 110003	276
18	Delhi	Ministry of Personnel, Public Grievances and Pensions	Samaj Kalyan Kendra, Moti Bagh North, Block F, Moti Bagh, New Delhi, Delhi 110021	276
19	Delhi	Ministry of Personnel, Public Grievances and Pensions	Grih Kalyan Kendra, Community Center, Maharani Lakshmi Bai Marg, Laxmi Bai Nagar, New Delhi, Delhi 110023	276
20	Delhi	Ministry of Culture	Lalit kala Akademi ministry of culture, Rabindra Bhavan, 35, Ferozeshah Road, New Delhi, Delhi 110001	205
21	Delhi	MHRD	Kendriya Vidyalaya Keshavpuram, A-2, Keshav Puram, Lowrence Road Industrial Area, Near Jain Mandir, Delhi, 110035	159
TOTAL				9237

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN HARYANA (3014.010 kWp) RESCO MODEL (INR 3.320 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Haryana	Ministry of Agriculture	ICAR-National Dairy Research Institute, Near Jewels Hotel, GT Rd, Nyaypuri, Karnal, Haryana 132001	1063
2	Haryana	MHRD	Guru Jambheshwar University of Science & Technology Hisar	545
3	Haryana	MHRD	Kendriya Vidyalaya No. 1 Ambala Cantt, Near Patel Park Haryana, Ambala, Haryana	422
4	Haryana	MHRD	Kanganpur Road, Kirti Nagar, Sirsa, Haryana 125055	379
5	Haryana	MHRD	Karnal	367
6	Haryana	MHRD	Abhor	323
		TOTAL		3100

Note:	*The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN KERALA (2892.600 kWp) RESCO MODEL (INR 3.970 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Kerala	Ministry of Textiles	National Institute Of Fashion Technology (NIFT), Kannur	462
2	Kerala	MHRD	Kendriya Vidyalaya No.1, Kochi, Kerala	379
3	Kerala	MHRD	Kendriya Vidyalaya, Pattom, Thiruvananthapuram, Kerala	365
4	Kerala	Ministry of Textiles	NTC,Mahatma Gandhi Road, Ernakulam South, Ernakulam, Kerala 682016	276
5	Kerala	MHRD	National Institute of Technology Calicut	276
6	Kerala	Ministry of Textiles	National Textile Corporation, Pullazhi, Thrssur, Kerela	276
7	Kerala	Ministry of Textiles	National Textile Corporation, Thrissur, Kerela	276
8	Kerala	Ministry of Agriculture	ICAR-CTCRI,Sreekariyam,Kerla	242
9	Kerala	MHRD	Kendriya Vidyalaya Ernakulam, Kochi, Kerala	234
10	Kerala	MHRD	Kendriya Vidyalaya,Pallippuram, Thiruvananthapuram, Kerala 695316	207
TOTAL				2992

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Page 1 of 1

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model
(PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN ODISHA (4287.060 kWp)
RESCO MODEL (INR 3.620 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Odisha	MHRD	Near NCC Office, Talabania, Purussottam Nagar, Puri, Odisha 752002	511
2	Odisha	MHRD	Bikrampur, Angul, Odisha 759122	500
3	Odisha	MHRD	BED College St, Ekamra Vihar, Kharabela Nagar, Bhubaneswar, Odisha 751001	495
4	Odisha	MHRD	Kendriya Vidyalaya, Berhampur, Gamjam, Odisha 760010	464
5	Odisha	MHRD	Gothapatna, PO Malipada, Bhubaneswar, Odisha 751003	454
6	Odisha	MHRD	Kendriya Vidyalaya, Malkangiri Gaudaguda, Odisha 764048	434
7	Odisha	MHRD	Kendriya Vidyalaya,Nabarangpur Chutiaguda, Odisha 764063	414
8	Odisha	MHRD	SH 1, Kandhamal, Phulbani, Odisha 762001	397
9	Odisha	MHRD	Kanheipur, Jajpur Road, Odisha 755019	357
10	Odisha	Ministry of Textiles	India Institute of Handloom Technology, Bargarh, Odisha	276
TOTAL				4302

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN PUNJAB (4408.020 kWp) RESCO MODEL (INR 3.320 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Punjab	MHRD	Guru Nanak Dev University, Grand Trunk Road, Off NH1, Amritsar, Punjab 143001	3316
2	Punjab	MHRD	G.H.G. Khalsa College, Gurusar Sadhar,GURUSAR SADHAR,TEHSIL RAIKOT,, LUDHIANA, Punjab 141104	512
3	Punjab	MHRD	Kenriya Vidyalaya No-1, Air force station Halwara, Halwara A.D.Distt Ludhiana. pin 141106	377
4	Punjab	Ministry of Culture	Maharaja Ranjit Singh Museum,Maharaja Ranjit Singh Bagh, Ram Bagh, Lawrence Road, Amritsar, Punjab 143001	207
TOTAL				4412

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN RAJASTHAN (7088.040 kWp)

RESCO MODEL (INR 3.190 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Rajasthan	MHRD	Lohia College Station Road, Churu (Rajasthan) - 331001	1557
2	Rajasthan	MHRD	Janaki Devi Bajaj Government Girls College, Near Antaghar Circle, Baran Rd, Nayapura, Kota, Rajasthan	1120
3	Rajasthan	MHRD	Rajasthan Technical University, Kota, National Highway 76, Akelgarh, Rajasthan Technical University, Akelgarh, Kota, Rajasthan	967
4	Rajasthan	MHRD	Kendriya Vidyalaya 1, Cantt Area, Jodhpur, Rajasthan 342006	966
5	Rajasthan	MHRD	National Law University, NH-65, Mandore Road, Mandor, Jodhpur, Rajasthan 342304	921
6	Rajasthan	MHRD	MLVT Engineering College, Pratap Nagar, Bhilwara, Rajasthan	544
7	Rajasthan	MHRD	Kendriya Vidyalaya, Itarana, Alwar, Rajasthan 301030	517
8	Rajasthan	MHRD	Kendriya Vidyalaya No. 2, Iitary Station, Jhotwara, Om Shiv Colony, Jhotwara, Jaipur, Rajasthan	428
9	Rajasthan	Ministry of Consumer Affairs, Food & Public Distribution	Bureau of Indian Standards, C Scheme, Ashok Nagar, Jaipur, Rajasthan	69
TOTAL				7088

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN UTTAR PRADESH (10946.300 kWp) RESCO MODEL (INR 3.910 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	Uttar Pradesh	MHRD	Gautam Buddha University, Yamuna Expressway, Gautam Budh Nagar, Near Pari Chowk, Greater Noida, Uttar Pradesh 201312	8497
2	Uttar Pradesh	MHRD	Kendriya Vidyalaya New Cantt, Allahabad, V.D. Road, Top Khana Bazar, Allahabad, Uttar Pradesh 211001	998
3	Uttar Pradesh	MHRD	Kendriya Vidyalay 3, Railway Quarters Rd, Railway Colony, Jhansi, Uttar Pradesh 284003	687
4	Uttar Pradesh	MHRD	Indian Institute of Management Lucknow, Prabandh Nagar, IIM Road, Lucknow, Uttar Pradesh 226013	610
5	Uttar Pradesh	MHRD	Kendriya Vidyalaya, Circular Road, Muzaffarnagar, Uttar Pradesh 251001	155
		TOTAL		10947

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN WEST BENGAL

(5502.870 kWp)

RESCO MODEL (INR 3.620 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
1	West Bengal	Ministry of Defence - Department of Ex-Servicemen Welfare	ECHS Polyclinic Kolkata Judge Court Road, Opp AIMS & BSNL Alipore Kolkata-27	276
2	West Bengal	Ministry of Culture	NCSM (HQRs) & CRTL Premises, 33, Block-GN, Sector-V, Salt Lake, Kolkata-700091	276
3	West Bengal	Ministry of Social Justice & Empowerment	NIOH Kolkata	276
4	West Bengal	MHRD	Kendriya Vidyalaya - No. 1 Ishapore ,No. 4 , The Park, Ichhapur Defence Estate, P.O. Ichapur, Nawabganj, West Bengal 743144	270
5	West Bengal	MHRD	Kendriya Vidyalaya Sukna ,Khoklong, West Bengal 7340009	256
6	West Bengal	MHRD	Kendriya Vidyalaya ,Sevoke Road, District Jalpaiguri, Salugara, West Bengal 734008	214
7	West Bengal	Ministry of Culture	North Bengal Science Centre ,Matigara, Siliguri, West Bengal 734010	207
8	West Bengal	MINISTRY OF CULTURE	Cooch Behar Rajbari ,Rajbari Gate on Keshab Road, Near Central Bus Terminus, Kesab Road, Cooch Behar, West Bengal 736101	207
9	West Bengal	MINISTRY OF CULTURE	Rajbari Gate on Keshab Road, Near Central Bus Terminus, Kesab Road, Cooch Behar, West Bengal 736101	207
10	West Bengal	MINISTRY OF CULTURE	Lalbagh - Hazarduari Rd, Hazarduari, Murshidabad, West Bengal 742149	207
11	West Bengal	MINISTRY OF CULTURE	Chowk Bazaar, Hazarduari Museum Rd, Hazarduari, Murshidabad, West Bengal 742149	207
12	West Bengal	MINISTRY OF CULTURE	Chowk Bazaar, Hazarduari Museum Rd, Hazarduari, Murshidabad, West Bengal 742149	207
13	West Bengal	Ministry of Culture	DSC PRULIA WEST BENGAL	207
14	West Bengal	Ministry of Culture	Bardhaman Science Centre ,University Rd, Bardhaman University, Burdwan, West Bengal 713104	207
15	West Bengal	MINISTRY OF CULTURE	Institut De Chandernagore,Strand Road, Chandernagore, Barabazar, Hooghly, West Bengal 712136	207
16	West Bengal	Ministry of Culture	Raja Rammohan Roy Library Foundation ,Block-DD - 34, Sector - I, Salt Lake City, Kolkata, West Bengal 700064	207
17	West Bengal	MINISTRY OF CULTURE	Synagogue St, Bara Bazar, Kolkata, West Bengal 700001	207
18	West Bengal	Ministry of Culture	National Council of Science Museums ,NCSM33, Block - GN, Sector - V, Bidhan Nagar, GN Block, Sector V, Salt Lake City, Kolkata, West Bengal 700091	207

Annexure-II

Implementation of 1000MW Grid Connected Roof Top Solar PV System Scheme for Government Buildings in Different States/ Union Territory of India for 500MW Identified Capacity under CAPEX/ RESCO Model (PHASE - I)

LIST OF PROPOSED SITES ALONGWITH PROPOSED INSTALLATION CAPACITY FOR M/s AZURE POWER ROOFTOP ONE PVT. LIMITED IN WEST BENGAL

(5502.870 kWp)

RESCO MODEL (INR 3.620 per kWh)

(INDICATIVE)

Sl. No.	State/ UT/ Island	Ministry	Name and Address of the Proposed Site	Indicative Rooftop Capacity (kWp)
19	West Bengal	Ministry of Consumer Affairs, Food & Public Distribution	NATIONAL TEST HOUSE ,Service Road, BP Block, Sector V, Salt Lake City, Kolkata, West Bengal 700091	207
20	West Bengal	MINISTRY OF CULTURE	Chitpur, BBD Bagh, Kolkata, West Bengal 700001	207
21	West Bengal	Ministry of Culture	Eastern Zonal Cultural Centre,IB 201, Sector III, IA Block, Salt Lake, Kolkata, West Bengal 700106	207
22	West Bengal	MINISTRY OF CULTURE	12, Strand Rd, BBD Bagh, Kolkata, West Bengal 700001	207
23	West Bengal	Ministry of Culture	Maulana Azad Museum, S, Ashraf Mistri Lane, Kolkata- 700019	207
24	West Bengal	MINISTRY OF CULTURE	11B, Dalhousie, Lal Dighi, BBD Bagh, Kolkata, West Bengal 700001	207
25	West Bengal	Ministry of Culture	Asiatic Society ,Asiatic Society,1, Park Street, Taltala, Kolkata, West Bengal 700016	207
26	West Bengal	Ministry of Culture	Science City, J.B.S Haldane Avenue, Kolkata, West Bengal 700046	207
TOTAL				5706

Note: *The list is purely indicative. The capacity is estimated considering 1 kWp=15 Sq Mtr. However, in actual scenario it may vary typically in the range of 12 Sq Mtr to 15 Sq Mtr as per the actual site conditions such as type of roof, shading, free space availability, load conditions etc. Accordingly the indicative Solar Roof Top Potential may also varySuccessful Bidder need to ascertain the feasibility of space including installation capacity and signing of PPA/ EPC Agreement in consultation with the owner of the building upon allocation by SECI.*

Annexure - III

Solar power Plant (Roof Top Insatallation under RESCO model) at Guru Nanak Dev University Amritsar

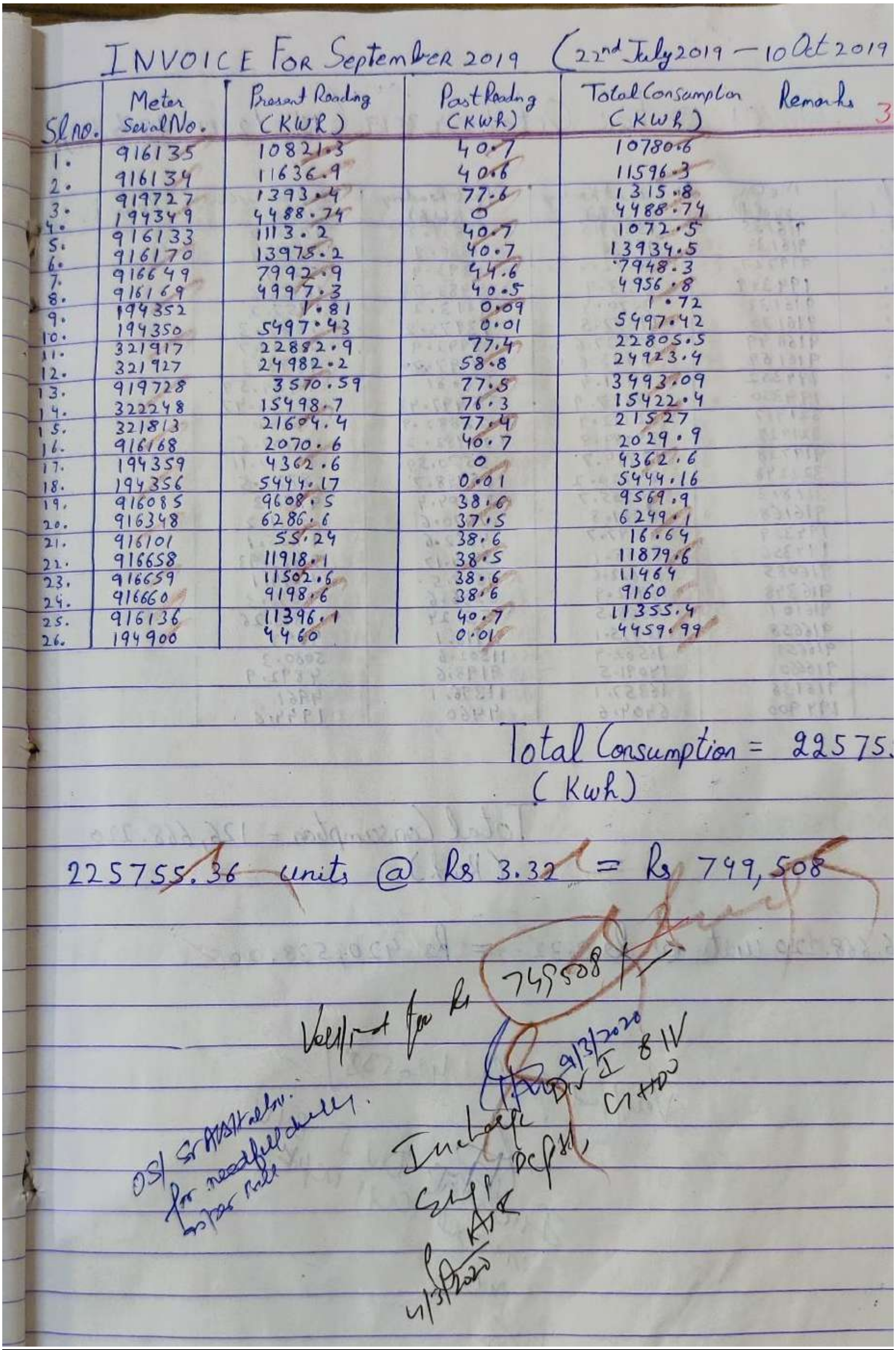
Date of Commissioning of Grid Connected Roof Top PV Solar Plant 22/07/2019*

Roof Top Location/Department building)	Capacicty (kWp)	Energy Generation (kWh)	
		JUL'19-Ap'20	May'20-Ap'21
Administrative Block	100		
Bhai Gurdas Library	100		
Bhai Gurdas Library	100		
Planning and Architecture	100		
Guru Nanak Bhavan	100		
Chemistry Department	50		
Chemistry Department	25		
School of Finacial Studies	25		
Education Department	40		
Social Science	50		
Physics Department	50		
Food Science Department	50		
Botanical and Environment Science	50		
Biology Department	50		
Girls' Hostel	65		
Boys' Hostel-3	25		
Lifelong Learning Department	50		
New Lecture Theatres Complex	50		
Electronics Department (old Building)	100		
Electronics Department (old Building)	20		
Zoravar Boys' Hostel	45		
Sociology and Economics	65		
Sports and Medicine	50		
University Business School	70		
Physiotherapy	25		
Maths	25		
Total Capacity	1480		
	Totak Energy Generation in kWh	8,72,919*	14,78,140

Annexure - IV

INDEX

Sl No.	Building Name	Capacity	Meter Serial No.
1.	Dept. of long life	50 KW	916135
2.	New Lecture Theatre	50 KW	916134
3.	Dept. of electronics	100 KW	919727
4.	Dept. of electronics	20 KW	194349
5.	Zorawar Boy's Hostel	45 KW	916133
6.	Dept. of Sociology & Economics	65 KW	916170
7.	Sports & Medicines	50 KW	916649
8.	University of Business School	70 KW	916169
9.	Dept. of Physiotherapy	25 KW	194352
10.	Dept. of Maths	25 KW	194350
11.	Administrative Block	100 KW	321917
12.	Bhai Gurdas library	100 KW	321927
13.	Bhai Gurdas library	100 KW	919728
14.	Planning & Arc	100 KW	322248
15.	Guru Nanak Bhawan	100 KW	321813
16.	Dept. of Chemistry	50 KW	916168
17.	Dept. of Chemistry	25 KW	194359
18.	University School of Financial Studies	25 KW	194356
19.	Dept of Education	40 KW	916085
20.	Social Science (Arts House)	50 KW	916348
21.	Dept. of Physics	50 KW	916101
22.	Dept. of food Science	50 KW	916658
23	Dept. of Botanical & Env. Science.	50 KW	916659
24	Dept. of Biology	50 KW	916660
25	Girls Hostel	65 KW	916136
26.	Boy's Hostel	25 KW	194900



INVOICE FOR September 2019 (22nd July 2019 – 10 Oct 2019

Sl no.	Meter Serial No.	Present Reading (KWR)	Past Reading (KWR)	Total Consumption (KWh)	Remarks
1.	916135	10821.3	40.7	10780.6	
2.	916134	11636.9	40.6	11596.3	
3.	919727	1393.4	77.6	1315.8	
4.	194349	4488.74	0	4488.74	
5.	916133	1113.2	40.7	1072.5	
6.	916170	13975.2	40.7	13934.5	
7.	916649	7992.9	44.6	7948.3	
8.	916169	4997.3	40.5	4956.8	
9.	194352	1.81	0.09	1.72	
10.	194350	5497.43	0.01	5497.42	
11.	321917	22882.9	77.4	22805.5	
12.	321927	24982.2	58.8	24923.4	
13.	919728	3570.59	77.5	3493.09	
14.	322248	15498.7	76.3	15422.4	
15.	321813	21604.4	77.4	21527	
16.	916168	2070.6	40.7	2029.9	
17.	194359	4362.6	0	4362.6	
18.	194356	5444.17	0.01	5444.16	
19.	916085	9608.5	38.6	9569.9	
20.	916348	6286.6	37.5	6249.1	
21.	916101	55.24	38.6	16.64	
22.	916658	11918.1	38.5	11879.6	
23.	916659	11502.6	38.6	11464	
24.	916660	9198.6	38.6	9160	
25.	916136	11396.1	40.7	11355.4	
26.	194900	4460	0.01	4459.99	

Total Consumption = 22575.
(KWh)

225755.36 units @ Rs 3.32 = Rs 749,508

Verified for Rs 749508

INVOICE FOR October 2019 (10 oct 2019 - 13 Nov 19)

Sl no.	Meter Serial No.	Present Reading (KWh)	Past Reading (KWh)	Total Consumption (KWh)	Remarks
1.	916135	15349.5	10821.3	4528.2	
2.	916134	16436	11636.9	4799.1	
3.	919727	8672.4	1393.4	7279	
4.	194349	6333.9	4488.74	1845.16	
5.	916133	3070.4	1113.2	1957.2	
6.	916170	19857.5	13975.2	5882.3	
7.	916649	10537.6	7992.9	2544.7	
8.	916169	6695.6	4997.3	1698.3	
9.	194352	1471.4	1.81	1469.59	
10.	194350	7827.9	5497.43	2330.47	
11.	321917	32122.9	22882.9	9240	
12.	321927	35089.8	24982.2	10107.6	
13.	919728	13784.7	3570.59	10214.11	
14.	322248	24220.2	15498.7	8721.5	
15.	321813	30755.7	21604.4	9151.3	
16.	916168	5381.8	2070.6	3311.2	
17.	194359	6297.7	4362.6	1935.1	
18.	194356	7858.1	5444.17	2413.93	
19.	916085	13622.6	9608.5	4014.1	
20.	916348	8962.9	6286.6	2676.3	
21.	916101	8868.5	55.24	8813.26	
22.	916658	16775.1	11918.1	4857	
23.	916659	16582.9	11502.6	5080.3	
24.	916660	14091.5	9198.6	4892.9	
25.	916136	16357.1	11396.1	4961	
26.	194900	6404.6	4460	1944.6	

Total Consumption = 126,668.220 (Kwh)

126,668.220 units @ Rs 3.32 = Rs 420,538.00

Verified for Rs. 420538/-

Incharge DIV I & IV Civil Deptt

GNDU

ASR

6/9/22

INVOICE FOR NOVEMBER 2019 (13 Nov 19 – 4 Dec 19)

Sl No.	Meter Serial No.	Present Reading (KWH)	Past Reading (KWH)	Total Consumption (KWH)	Remarks
1.	916135	17586.7	15349.5	2237.2	
2.	916134	18872.5	16436	2436.5	
3.	919727	14004.3	8672.4	5331.9	
4.	194349	7373.1	6333.9	1039.2	
5.	916133	4986.5	3070.4	1916.1	
6.	916170	22787.9	19857.5	2930.4	
7.	916849	13049	10537.6	2511.4	
8.	916169	7583.4	6695.6	887.8	
9.	194352	2433.8	1471.8	962.4	
10.	194350	8950.7	7827.9	1122.8	
11.	321917	36533.7	32122.9	4410.8	
12.	321927	40188.4	35089.8	5098.6	
13.	919728	18993.8	13784.7	5209.1	
14.	322248	28843.4	24220.2	4623.2	
15.	321813	35309.8	30755.7	4554.1	
16.	916168	7189.2	5381.8	1807.4	
17.	194359	7271.4	6297.7	973.7	
18.	194356	9225	7858.1	1366.9	
19.	916085	15646.9	13622.6	2024.3	
20.	916348	10103	8962.9	1140.1	
21.	916101	11431	8868.5	2562.5	
22.	916658	19326.7	16775.1	2551.6	
23.	916659	19144.4	16582.9	2561.5	
24.	916660	16542.9	14091.5	2451.4	
25.	916136	18776.5	16357.1	2419.4	
26.	194900	7312.4	6404.6	907.8	

Total Consumption = 66,038.100 (KWH)

66,038.100 units @ Rs 3.32 = Rs 219,246.00

Verified for Rs 219246/-

Enclosed DIV I & IV

EMS Deptt GNDU,

4/12

INVOICE FOR DECEMBER'2019 (4 Dec 2019 – 31 Dec 2019) 6.

Sl no.	Meter Serial no.	Present Reading (KWH)	Past Reading (KWH)	Total Consumption (KWH)	Remarks
1.	916135	19405	17586.7	1818.3	
2.	916134	20818	18872.5	1945.5	
3.	919727	18535	14004.3	4530.7	
4.	194349	8301	7373.1	927.9	
5.	916133	5068	4986.5	81.5	
6.	916170	25148	22787.5	2360.1	
7.	916649	14961	13049	1912	
8	916169	8323	7583.4	739.6	
9.	194352	3212	2433.8	778.2	
10.	194350	9884	8950.7	933.3	
11.	321917	40195	36533.7	3661.3	
12	321927	44273	40188.4	4084.6	
13	919728	23129	18993.8	4135.2	
14	322248	32462	28843.4	3618.6	
15	321813	39070	35309.8	3760.2	
16	916168	8677	7189.2	1487.8	
17.	194359	8004	7271.4	732.6	
18.	194356	10395	9225	1170	
19.	916085	17373	15646.9	1726.1	
20.	916348	11119	10103	1016	
21.	916101	13607	11431	2176	
22.	916658	21476	19326.7	2149.3	
23.	916659	21288	19144.4	2143.6	
24.	916660	18624	16542.9	2081.1	
25.	916136	20828	18776.5	2051.5	
26.	194900	8097	7312.4	784.6	

Total Consumption = 52,805.600 (KWH)

52,805.600 units @ Rs 3.32 = Rs 175,315.00

Verified for Rs 175315/-

Incharge C.M.S Deptt.

748508
420538
218246
175315
1564607

Passed for R. 1564607/-

Ch. No. 710906 Dt. 27/05/2020

Incharge
Engineering Department,
Guru Nanak Dev University,
Amritsar.

INvoice FOR JANUARY'2020 [31 Dec 2019 - 05 Feb 2020]

SL No	METER Serial No.	Present Reading (KWH)	Past Reading (KWH)	Total Consumption (KWH)	Remarks
1	916135	23097	19405	3692	
2	916134	24814	20818	3996	
3	919727	26437	18535	7902	
4	194349	9559	8301	1258	
5	916133	6849	5068	1781	
6	916170	29996	25148	4848	
7	916649	19134	14961	4173	
8	916169	9872	8323	1549	
9	194352	4863	3212	1651	
10	194350	11295	9884	1411	
11	321917	47129	40195	6934	
12	321927	53013	44293	8740	
13	919728	31939	23129	8810	
14	322248	40320	32462	7858	
15	321813	46628	39070	7558	
16	916168	11695	8677	3018	
17	194359	9572	8004	1568	
18	194356	12398	10395	2003	
19	916085	20725	17373	3352	
20	916348	13304	11119	2185	
21	916101	17880	13607	4273	
22	916658	25816	21476	4340	
23	916659	25427	21288	4139	
24	916660	22508	18624	3884	
25	916136	24794	20828	3966	
26	194900	8890	8097	793	

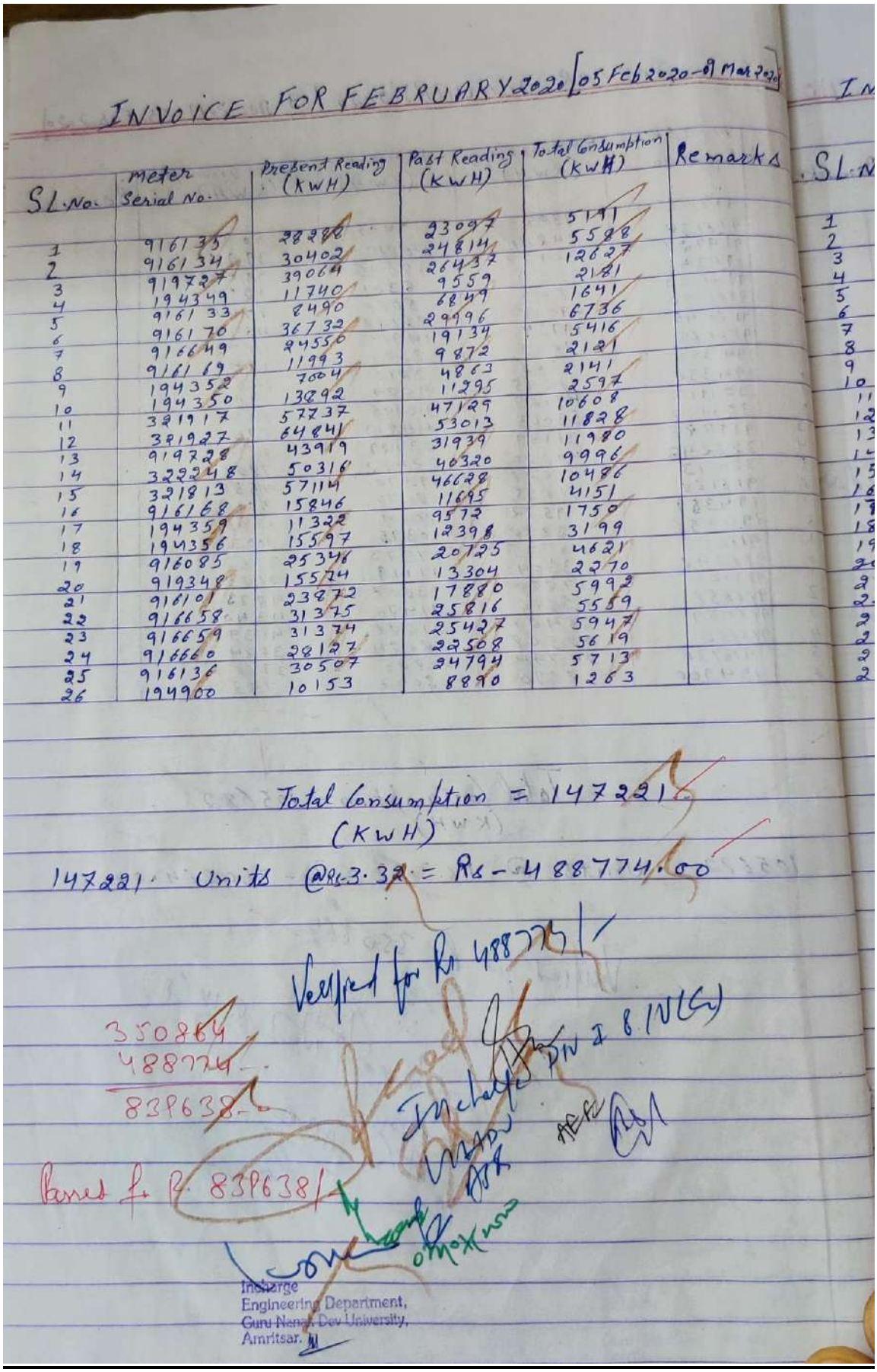
Total Consumption = 105682 (KWH)

105682 Units @ Rs. 3.32 = Rs - 350864.00.

Verified for Rs. 350864

In charge

AE &



INVOICE FOR FEBRUARY 2020 [05 Feb 2020 - 01 Mar 2020]

SL.No.	Meter Serial No.	Present Reading (KWH)	Past Reading (KWH)	Total Consumption (KWH)	Remarks
1	916135	28288	23097	5191	
2	916134	30402	24814	5588	
3	919727	39064	26437	12627	
4	194349	11740	9559	2181	
5	916133	8490	6849	1641	
6	916170	36732	29996	6736	
7	916649	24550	19134	5416	
8	916169	11993	9872	2121	
9	194352	7004	4863	2141	
10	194350	13892	11295	2597	
11	321917	57737	47129	10608	
12	321927	64841	53013	11828	
13	919728	43919	31939	11980	
14	322248	50316	40320	9996	
15	321813	57114	46628	10486	
16	916168	15846	11695	4151	
17	194359	11322	9572	1750	
18	194356	15597	12398	3199	
19	916085	25346	20725	4621	
20	919348	15574	13304	2270	
21	916101	23872	17880	5992	
22	916658	31375	25816	5559	
23	916659	31374	25427	5947	
24	916660	28127	22508	5619	
25	916136	30507	24794	5713	
26	194900	10153	8890	1263	

Total Consumption = 147221
(KWH)

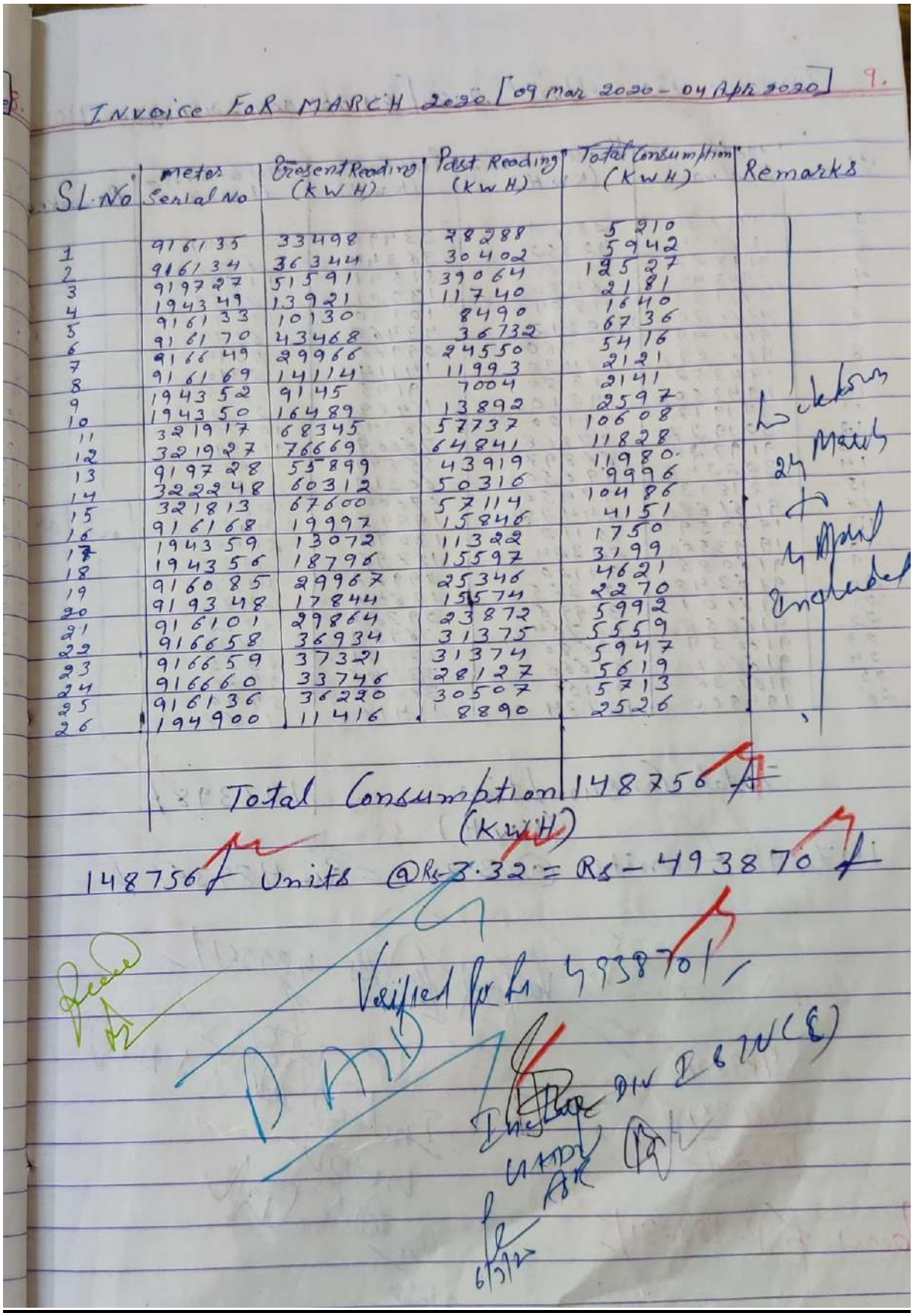
147221 Units @Rs-3.32 = Rs-488774.00

Verified for Rs 488774/-

350864
488774
839638

Passed for Rs. 839638/-

Incharge
Engineering Department,
Guru Nanak Dev University,
Amritsar.



INVOICE FOR MARCH 2020 [09 Mar 2020 - 04 Apr 2020] 9.

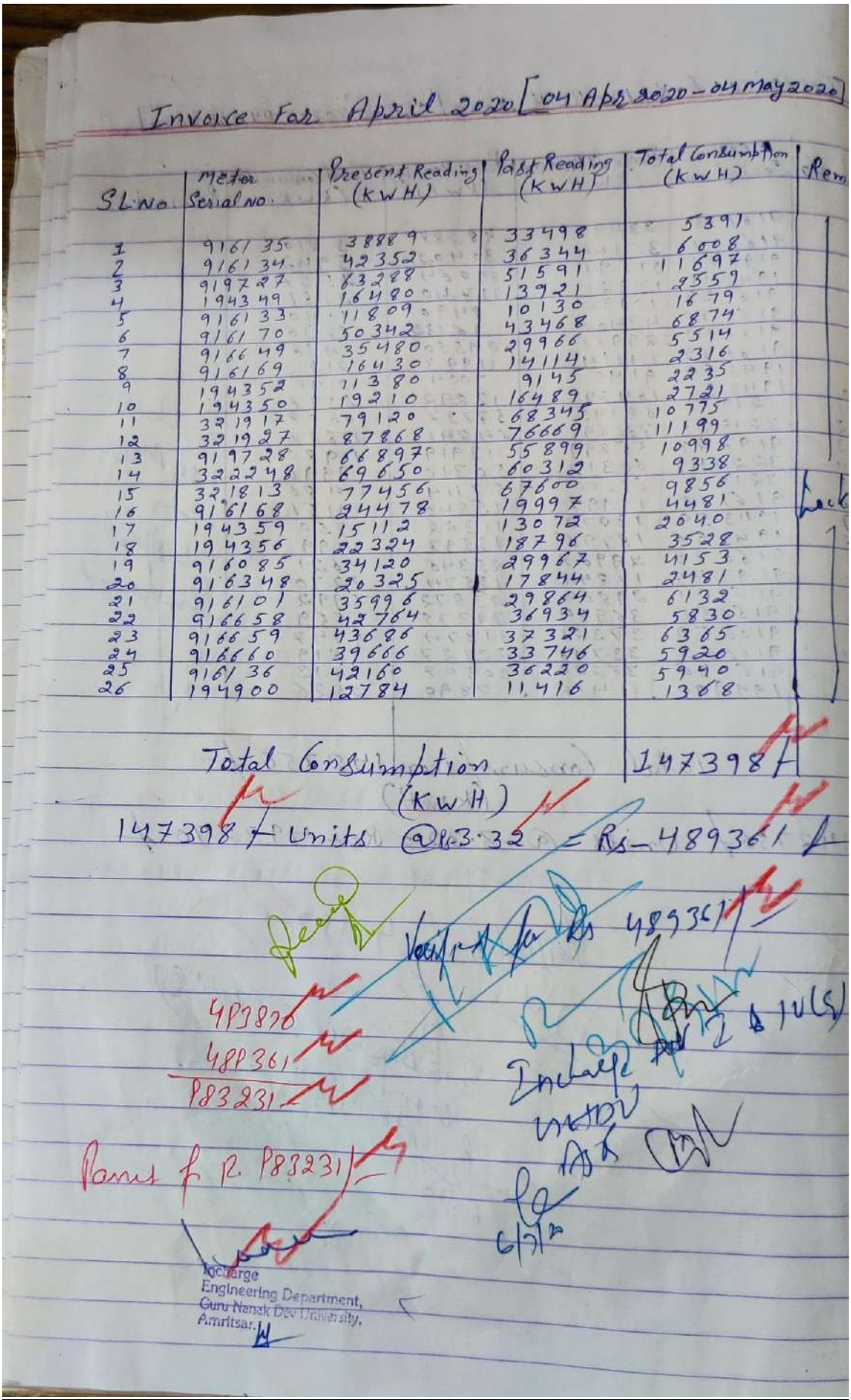
SL No	Meter Serial No	Present Reading (KWH)	Past Reading (KWH)	Total Consumption (KWH)	Remarks
1	916135	33498	28288	5210	
2	916134	36344	30402	5942	
3	919727	51591	39064	12527	
4	194349	13921	11740	2181	
5	916133	10130	8490	1640	
6	916170	43468	36732	6736	
7	916649	29966	24550	5416	
8	916169	14114	11993	2121	
9	194352	9145	7004	2141	
10	194350	16489	13892	2597	
11	321917	68345	57737	10608	
12	321927	76669	64841	11828	
13	919728	55899	43919	11980	
14	322248	60312	50316	9996	
15	321813	67600	57114	10486	
16	916168	19997	15846	4151	
17	194359	13072	11322	1750	
18	194356	18796	15597	3199	
19	916085	29967	25346	4621	
20	919348	17844	15574	2270	
21	916101	29864	23872	5992	
22	916658	36934	31375	5559	
23	916659	37321	31374	5947	
24	916660	33746	28127	5619	
25	916136	36220	30507	5713	
26	194900	11416	8890	2526	

Lockdown 24 March + 4 April Included

Total Consumption (KWH) 148256

148756 Units @Rs 3.32 = Rs - 493870

Verified for Rs 493870/-



Invoice For April 2020 [04 Apr 2020 - 04 May 2020]

Sl No	Meter Serial No	Present Reading (KWH)	Last Reading (KWH)	Total Consumption (KWH)	Rem
1	916135	38889	33498	5391	
2	916134	42352	36344	6008	
3	919727	83288	51591	11697	
4	194349	16480	13921	2559	
5	916133	11809	10130	1679	
6	916170	50342	43468	6874	
7	916649	35480	29966	5514	
8	916169	16430	14114	2316	
9	194352	11380	9145	2235	
10	194350	19210	16489	2721	
11	321917	79120	68345	10775	
12	321927	87868	76669	11199	
13	919728	66897	55899	10998	
14	322248	69650	60312	9338	
15	321813	77456	67600	9856	
16	916168	24478	19997	4481	
17	194359	15112	13072	2040	
18	194356	22324	18796	3528	
19	916085	34120	29967	4153	
20	916348	20325	17844	2481	
21	916101	35996	29864	6132	
22	916658	42764	36934	5830	
23	916659	43686	37321	6365	
24	916660	39666	33746	5920	
25	916136	42160	36220	5940	
26	194900	12784	11416	1368	

Total Consumption (KWH) 147398

147398 Units @ 3.32 = Rs- 489361

Verified for Rs 489361

489870

488361

983231

Pamt for Rs. 983231

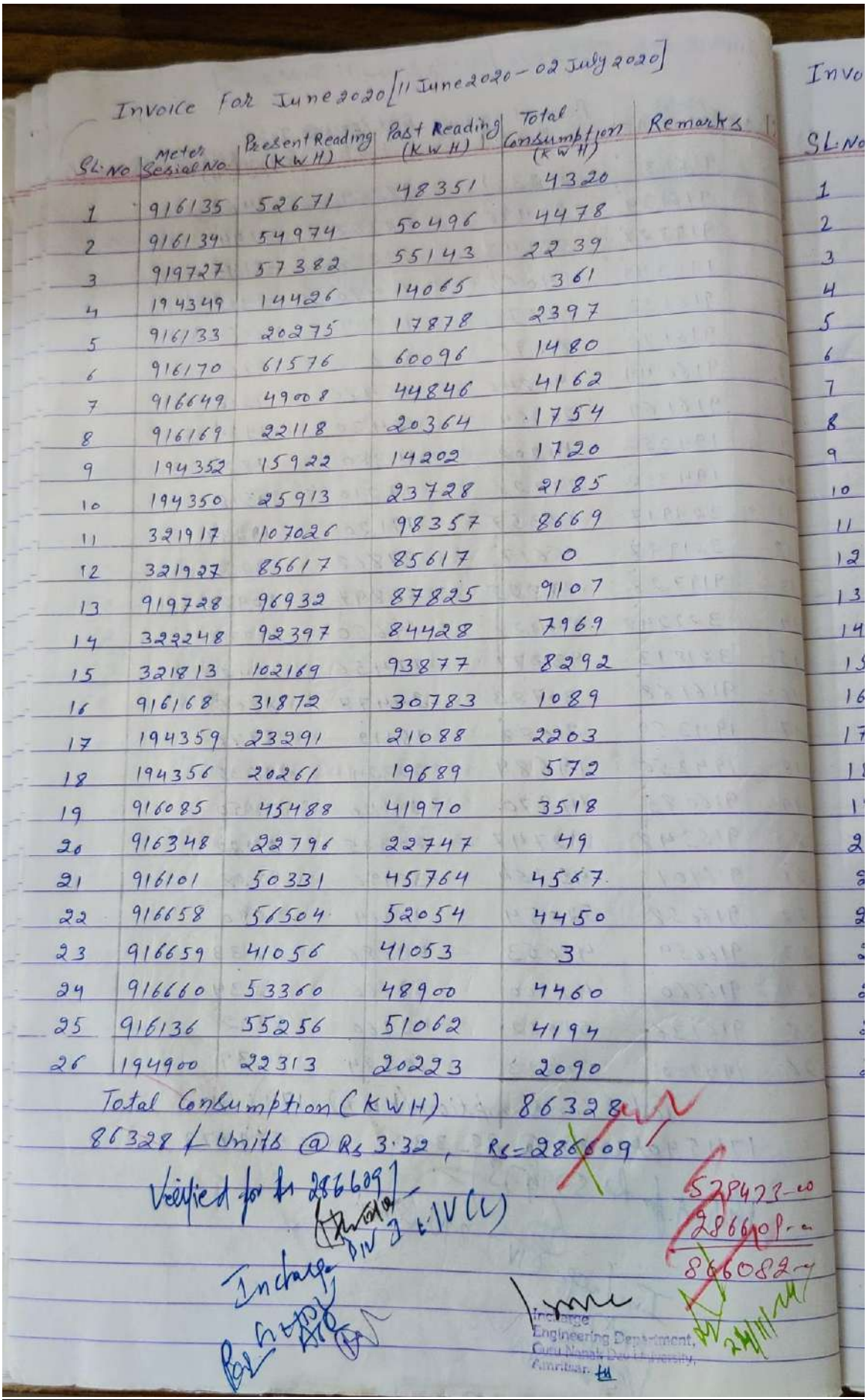
Incharge
Engineering Department,
Guru Nanak Dev University,
Amritsar.

Invoice For May 2020 [04 May 2020 – 11 June 2020]

Sl. No	Meter Serial No	Present Reading (KWH)	Past Reading (KWH)	Total Consumption (KWH)	Remarks
1	916135	48351	38889	9462	
2	916134	50496	42352	8144	
3	919727	55143	63288	-8145	
4	194349	14065	16480	-2415	
5	916133	17878	11809	6069	
6	916170	60096	50342	9754	
7	916649	44846	35480	9366	
8	916169	20364	16430	3934	
9	194352	14202	11380	2822	
10	194350	23728	19210	4518	
11	321917	98357	79120	19237	
12	321927	85617	87868	-2251	
13	919728	87825	66897	20928	
14	322248	84428	69650	14778	
15	321813	93877	77456	16421	
16	916168	30783	24478	6305	
17	194359	21088	15112	5976	
18	194356	19689	22324	-2635	
19	916085	41970	34120	7850	
20	916348	22747	20325	2422	
21	916101	45764	35996	9768	
22	916658	52054	42764	9290	
23	916659	41053	43686	-2633	
24	916660	48900	39666	9234	
25	916136	51062	42160	8902	
26	194900	20223	12784	7439	
		Total Consumption (KWH)		174540	

174540 Units @ Rs. 3.32, Rs = 579473

Verified for Rs 579473



Invoice for June 2020 [11 June 2020 – 02 July 2020]

Sl. No	Meter Serial No	Present Reading (KWH)	Past Reading (KWH)	Total Consumption (KWH)	Remarks
1	916135	52671	48351	4320	
2	916134	54974	50496	4478	
3	919727	57382	55143	2239	
4	194349	14426	14065	361	
5	916133	20275	17878	2397	
6	916170	61576	60096	1480	
7	916649	49008	44846	4162	
8	916169	22118	20364	1754	
9	194352	15922	14202	1720	
10	194350	25913	23728	2185	
11	321917	107026	98357	8669	
12	321927	85617	85617	0	
13	919728	96932	87825	9107	
14	322248	92397	84428	7969	
15	321813	102169	93877	8292	
16	916168	31872	30783	1089	
17	194359	23291	21088	2203	
18	194356	20261	19689	572	
19	916085	45488	41970	3518	
20	916348	22796	22747	49	
21	916101	50331	45764	4567	
22	916658	56504	52054	4450	
23	916659	41056	41053	3	
24	916660	53360	48900	4460	
25	916136	55256	51062	4194	
26	194900	22313	20223	2090	

Total Consumption (KWH) 86328

86328 / Units @ Rs 3.32, Rs = 286609

Verified for Rs 286609/-

Incharge

Incharge
Engineering Department,
Guru Nanak Dev University,
Amritsar.

529423-00
286609-00
242814-00

Invoice For July 2020 [02 July 2020 – 25 August 2020]

12. SL No	Meter Serial No	Present Reading (KWH)	Past Reading (KWH)	Total Consumption	Remarks 13.
1	916135	62852	52671	10181	
2	916134	65922	54974	10948	
3	919727	58773	57382	1391	
4	194349	14448	14426	22	
5	916133	25996	20275	5721	
6	916170	64861	61576	3285	
7	916649	58990	49008	9982	
8	916169	26510	22118	4392	
9	194352	16364	15922	442	
10	194350	31059	25913	5146	
11	321917	128706	107026	21680	
12	321927	85617	85617	0	
13	919728	119326	96932	22394	
14	322248	108118	92397	15721	
15	321813	122340	102169	20171	
16	916168	34170	31872	2298	
17	194359	28550	23291	5259	
18	194356	20626	20261	365	
19	916085	54063	45488	8575	
20	916348	22933	22796	137	
21	916101	61520	50331	11189	
22	916658	65093	56504	8589	
23	916659	51062	41056	10006	
24	916660	64261	53360	10901	
25	916136	65864	55256	10608	
26	194900	27262	22313	4949	
	Total Consumption (KWH)			204352	

204352/- Units @ Rs-3.32, Rs = 678449/-

Verified for Rs 6,78,449/-

Dr I & IV(C)

Invoice For August 2020 [25 August 2020 – 30 September 2020]

SL.No	Meter SL.No	Present Reading (KWH)	Past Reading (KWH)	Total Consumption	Remarks
1	916135	69378	62852	6526	
2	916134	72671	65922	6749	
3	919727	65868	58773	7095	
4	194349	15491	14448	1043	
5	916133	29873	25996	3877	
6	916170	70505	64861	5644	
7	916649	65719	58990	6729	
8	916169	29187	26510	2677	
9	194352	16374	16364	10	
10	194350	34288	31059	3229	
11	321917	141983	128706	13277	
12	321927	85617	85617	0	
13	919728	133806	119326	14480	
14	322248	108686	108118	568	
15	321813	134994	122340	12654	
16	916168	34175	34170	5	
17	194359	31980	28550	3430	
18	194356	22408	20626	1782	
19	916085	59401	54063	5338	
20	916348	22974	22933	41	
21	916101	67575	61520	6055	
22	916658	65253	65093	160	
23	916659	58092	51062	7030	
24	916660	71050	64261	6789	
25	916136	67075	65864	1211	
26	194900	30455	27262	3193	
Total Consumption (KWH)				119592	

119592 Units @ Rs-3.32, Rs = 397,045/-

Verified for Rs 397,045/-

Incharge Div I [illegible]

Invoice For September 2020 [30 September 2020 – 27 October 2020]

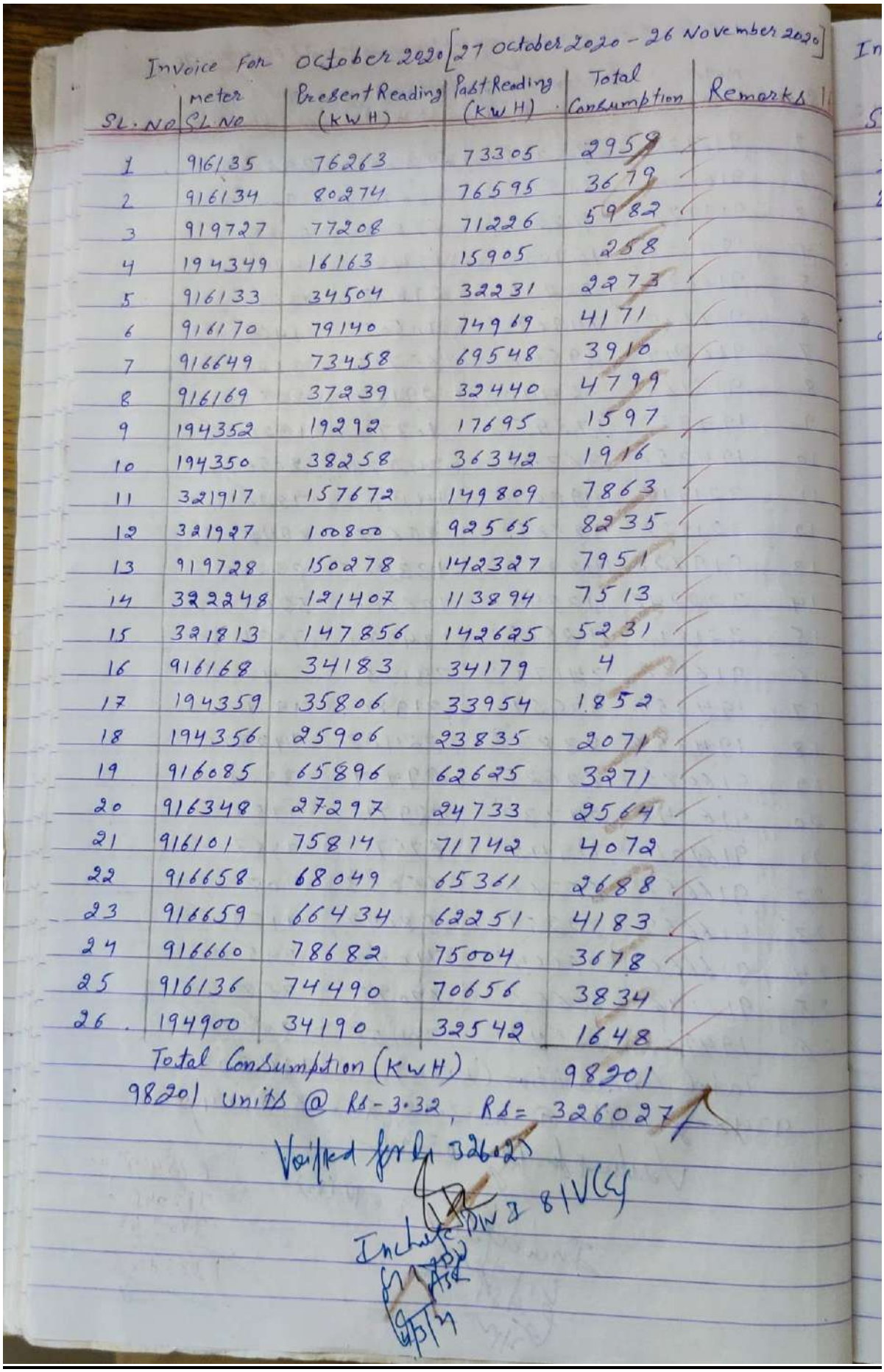
SL.NO	Meter SL.NO	Present Reading (KWH)	Past Reading (KWH)	Total Consumption
1	916135	73305	69378	3927
2	916134	76595	72671	3924
3	919727	71226	65868	5358
4	194349	15905	15491	414
5	916133	32231	29873	2358
6	916170	74969	70505	4464
7	916649	69548	65719	3829
8	916169	32440	29187	3253
9	194352	17695	16374	1321
10	194350	36342	34288	2054
11	321917	149809	141983	7826
12	321927	92565	85617	6948
13	919728	142327	133806	8521
14	322248	113894	108686	5208
15	321813	142625	134994	7631
16	916168	34179	34175	4
17	194359	33954	31980	1974
18	194356	23835	22408	1427
19	916085	62625	59401	3224
20	916348	24733	22974	1759
21	916101	71742	67575	4167
22	916658	65361	65253	108
23	916659	62251	58092	4159
24	916660	75004	71050	3954
25	916136	70656	67075	3581
26	194900	32542	30455	2087
	Total Consumption (KWH)			93480

93480/ Units @ Rs-3.32, Rs= 310354/-

Verified for Rs 310354/-

Incharge Div I & IV (E)

678449/-
397045/-
310354/-
1385848/-



Invoice for October 2020 [27 October 2020 - 26 November 2020]

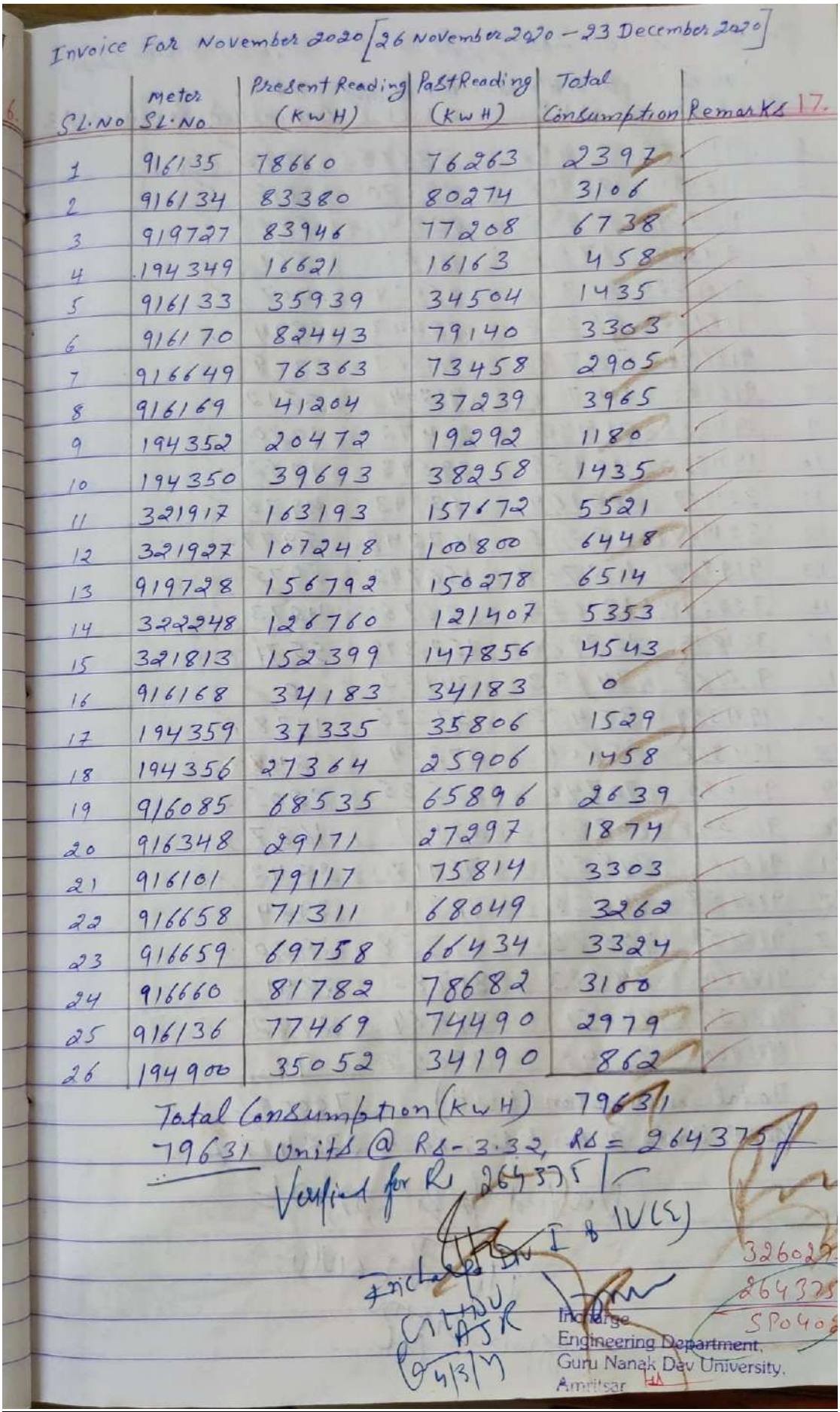
Sl. No	meter Sl No	Present Reading (KWH)	Past Reading (KWH)	Total Consumption	Remarks
1	916135	76263	73305	2958	
2	916134	80274	76595	3679	
3	919727	77208	71226	5982	
4	194349	16163	15905	258	
5	916133	34504	32231	2273	
6	916170	79140	74969	4171	
7	916649	73458	69548	3910	
8	916169	37239	32440	4799	
9	194352	19292	17695	1597	
10	194350	38258	36342	1916	
11	321917	157672	149809	7863	
12	321927	100800	92565	8235	
13	919728	150278	142327	7951	
14	322248	121407	113894	7513	
15	321813	147856	142625	5231	
16	916168	34183	34179	4	
17	194359	35806	33954	1852	
18	194356	25906	23835	2071	
19	916085	65896	62625	3271	
20	916348	27297	24733	2564	
21	916101	75814	71742	4072	
22	916658	68049	65361	2688	
23	916659	66434	62251	4183	
24	916660	78682	75004	3678	
25	916136	74490	70656	3834	
26	194900	34190	32542	1648	

Total Consumption (KWH) 98201

98201 units @ Rs-3.32, Rs= 326027/-

Vouched for Rs 326.25

Inclusive



Invoice For November 2020 [26 November 2020 – 23 December 2020]

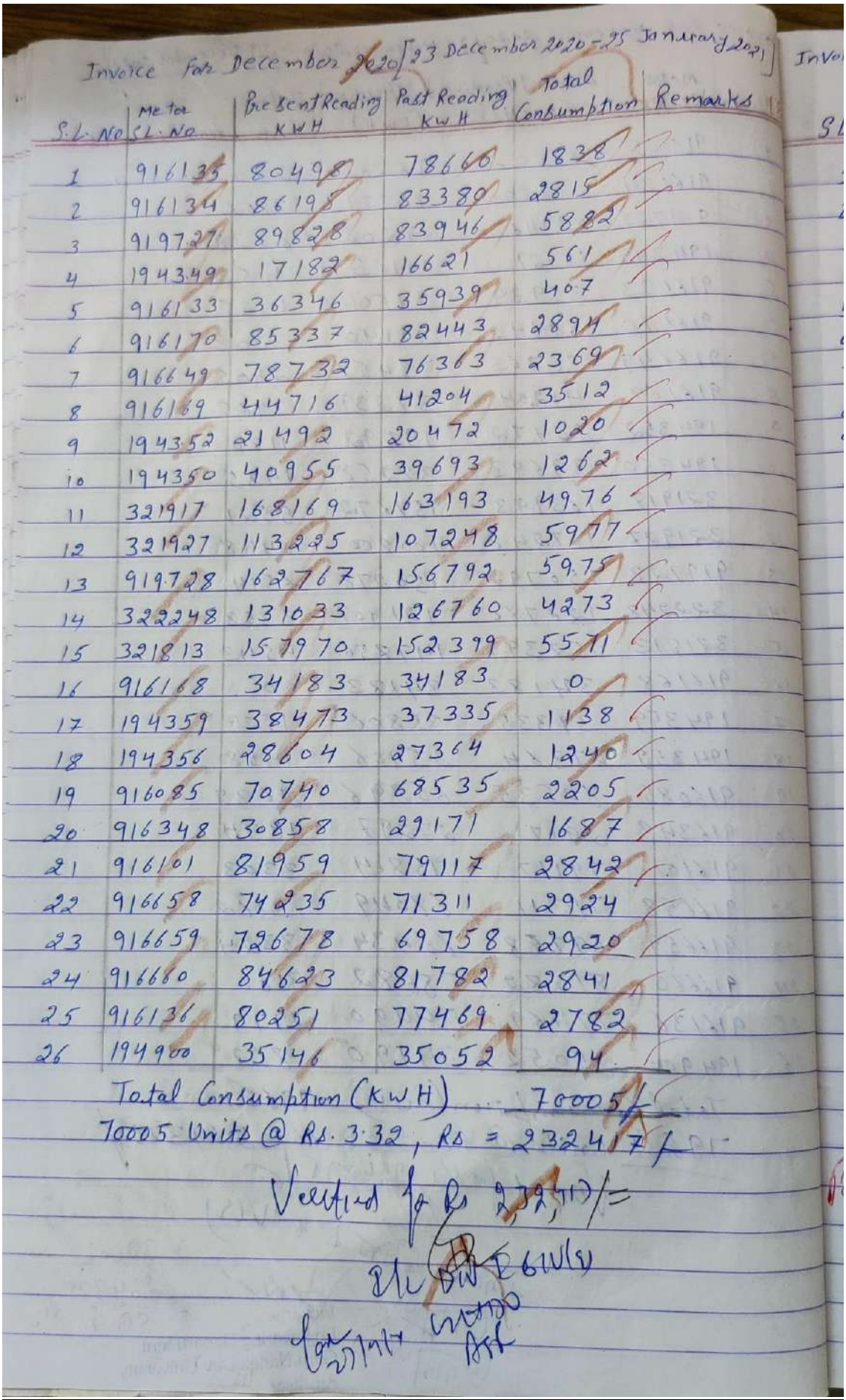
Sl.No	Meter Sl.No	Present Reading (KWH)	Past Reading (KWH)	Total Consumption	Remarks
1	916135	78660	76263	2397	
2	916134	83380	80274	3106	
3	919727	83946	77208	6738	
4	194349	16621	16163	458	
5	916133	35939	34504	1435	
6	916170	82443	79140	3303	
7	916649	76363	73458	2905	
8	916169	41204	37239	3965	
9	194352	20472	19292	1180	
10	194350	39693	38258	1435	
11	321917	163193	157672	5521	
12	321927	107248	100800	6448	
13	919728	156792	150278	6514	
14	322248	126760	121407	5353	
15	321813	152399	147856	4543	
16	916168	34183	34183	0	
17	194359	37335	35806	1529	
18	194356	27364	25906	1458	
19	916085	68535	65896	2639	
20	916348	29171	27297	1874	
21	916101	79117	75814	3303	
22	916658	71311	68049	3262	
23	916659	69758	66434	3324	
24	916660	81782	78682	3100	
25	916136	77469	74490	2979	
26	194900	35052	34190	862	

Total Consumption (KWH) 79631

79631 Units @ Rs-3.32, Rs = 264375/-

∴ Verified for Rs 264375/-

Incharge
Engineering Department,
Guru Nanak Dev University,
Amritsar



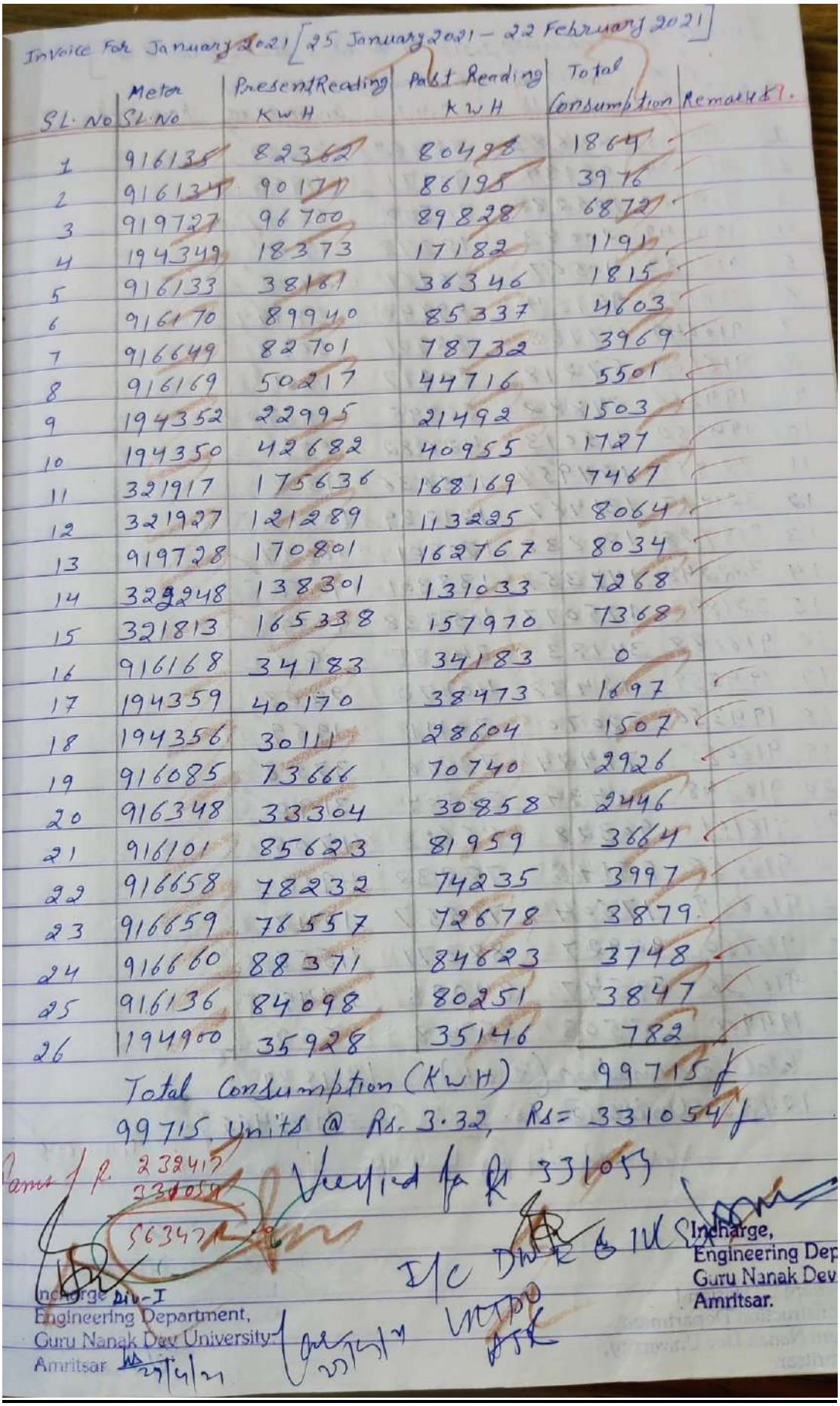
Invoice for December 2020 [23 December 2020 - 25 January 2021]

S.L. No	Meter SL. No	Present Reading KWH	Past Reading KWH	Total Consumption	Remarks
1	916135	80498	78660	1838	
2	916134	86195	83380	2815	
3	919727	89828	83946	5882	
4	194349	17182	16621	561	
5	916133	36346	35939	407	
6	916170	85337	82443	2894	
7	916649	78732	76363	2369	
8	916169	44716	41204	3512	
9	194352	21492	20472	1020	
10	194350	40955	39693	1262	
11	321917	168169	163193	4976	
12	321927	113225	107248	5977	
13	919728	162767	156792	5975	
14	322248	131033	126760	4273	
15	321813	157970	152399	5571	
16	916168	34183	34183	0	
17	194359	38473	37335	1138	
18	194356	28604	27364	1240	
19	916085	70740	68535	2205	
20	916348	30858	29171	1687	
21	916101	81959	79117	2842	
22	916658	74235	71311	2924	
23	916659	72678	69758	2920	
24	916660	84623	81782	2841	
25	916136	80251	77469	2782	
26	194900	35146	35052	94	

Total Consumption (KWH) ... 70005/-

70005 Units @ Rs. 3.32, Rs = 232417/-

Verified for Rs 2,32,417/=



Invoice For January 2021 [25 January 2021 – 22 February 2021]

Sl. No	Meter Sl. No	Present Reading KWH	Past Reading KWH	Total Consumption	Remarks
1	916135	82362	80498	1864	
2	916134	90171	86195	3976	
3	919727	96700	89828	6872	
4	194349	18373	17182	1191	
5	916133	38181	36346	1815	
6	916170	89940	85337	4603	
7	916649	82701	78732	3969	
8	916169	50217	44716	5501	
9	194352	22995	21492	1503	
10	194350	42682	40955	1727	
11	321917	175636	168169	7467	
12	321927	121289	113225	8064	
13	919728	170801	162767	8034	
14	322948	138301	131033	7268	
15	321813	165338	157970	7368	
16	916168	34183	34183	0	
17	194359	40170	38473	1697	
18	194356	30111	28604	1507	
19	916085	73666	70740	2926	
20	916348	33304	30858	2446	
21	916101	85623	81959	3664	
22	916658	78232	74235	3997	
23	916659	76557	72678	3879	
24	916660	88371	84623	3748	
25	916136	84098	80251	3847	
26	194900	35928	35146	782	

Total Consumption (KWH) 99715 ✓

99715 Units @ Rs. 3.32, Rs = 331054 ✓

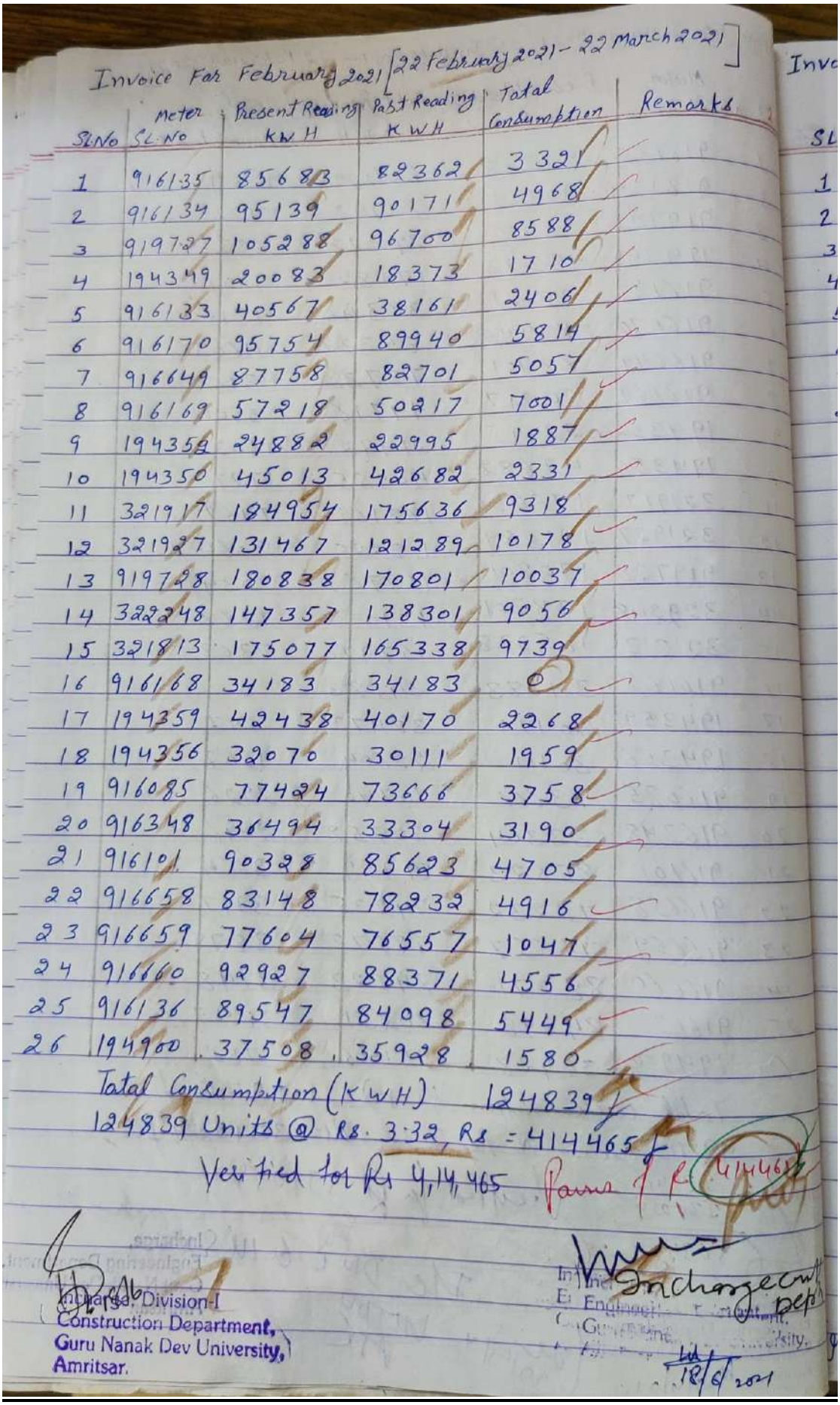
Amt / R. 232417
331054
56347

Verified for Rs 331054

Incharge Div-I
Engineering Department,
Guru Nanak Dev University
Amritsar

I/C DWR & IC

Incharge,
Engineering Dep
Guru Nanak Dev
Amritsar.



Invoice For February 2021 [22 February 2021 – 22 March 2021]

Sl.No	Meter Sl. No	Present Reading KWH	Past Reading KWH	Total Consumption	Remarks
1	916135	85683	82362	3321	
2	916134	95139	90171	4968	
3	919727	105288	96700	8588	
4	194349	20083	18373	1710	
5	916133	40567	38161	2406	
6	916170	95754	89940	5814	
7	916649	87758	82701	5057	
8	916169	57218	50217	7001	
9	194358	24882	22995	1887	
10	194350	45013	42682	2331	
11	321917	184954	175636	9318	
12	321927	131467	121289	10178	
13	919728	180838	170801	10037	
14	322248	147357	138301	9056	
15	321813	175077	165338	9739	
16	916168	34183	34183	0	
17	194359	42438	40170	2268	
18	194356	32070	30111	1959	
19	916085	77424	73666	3758	
20	916348	36494	33304	3190	
21	916101	90328	85623	4705	
22	916658	83148	78232	4916	
23	916659	77604	76557	1047	
24	916660	92927	88371	4556	
25	916136	89547	84098	5449	
26	194900	37508	35928	1580	

Total Consumption (KWH) 124839

124839 Units @ Rs. 3.32, Rs = 414465

Verified for Rs 4,14,465 Paras ₹ 414465

Incharge Division-I
Construction Department,
Guru Nanak Dev University,
Amritsar.

In-charge Civil Dept.
Engineering Department
Guru Nanak Dev University
18/6/2021

Invoice For March 2021 [22 March 2021 - 23 April 2021]

Sl. No	meter Sl. No	Present Reading KWH	Past Reading KWH	Total Consumption	Remarks
1	916135	91504	85683	5821	
2	916134	102083	95139	6944	
3	919727	119510	105288	14222	
4	194349	22909	20083	2826	
5	916133	44202	40567	3635	
6	916170	104158	95754	8404	
7	916649	94823	87758	7065	
8	916169	67144	57218	9926	
9	194352	27821	24882	2939	
10	194350	48338	45013	3325	
11	321917	198059	184954	13105	
12	321927	145574	131467	14107	
13	919728	194988	180838	14150	
14	322248	160221	147357	12864	
15	321813	188532	175077	13455	
16	916168	34183	34183	0	
17	194359	45775	42438	3337	
18	194356	35650	32070	3580	
19	916085	83013	77424	5589	
20	916348	40825	36494	4331	
21	916101	97518	90328	7190	
22	916658	90060	83148	6912	
23	916659	81260	77604	3656	
24	916660	99747	92927	6820	
25	916136	92684	89547	3137	
26	194900	40219	37508	2711	

Total Consumption (KWH) - 180051

180051 Units @ Rs. 3.32, Rs = 597769/-

Verified for Rs 597769/-

Incharge, Division IV
Construction Department,
Guru Nanak Dev University,
Amritsar.

Annexure – V

Total Electricity usage on Campus:-

Category	Consumption (kwh) Monthly for 12 Months
Department Wise	232589.75x12 = 2791071kwh
Residential Area	77344.83x12 = 928138 kwh
Utilities	200941.75 x 12 = 2411301 kwh

Bifurcation of Electricity for Different Purposes if Possible

Category	Consumption (kwh) Monthly for 12 Months
Lighting	64074 x 12 = 768888 kwh
Cooling	315194 x 12 = 3782328 kwh
Water Pumping	61560 x 12 = 738720 kwh
Wastewater Treatment	32940 x 12 = 395280 kwh
Any Other	37108 x 12 = 445296 kwh

Information About Electricity Cuts:_____ her on_____ days

Alternative Sources of electricity Generation

Source	**Capacity/ Number**
Solar	Nill
DG Sets	500 kva x 2 nos 380 kva x 2 nos
Inverters	500 watt x 150 nos
Others	Nill
Stationary Combustion (DG sets):- Fuel Consumed is DG sets to produce electricity_____1100Litre_____(monthly)	

Incharge Division-IV
Construction Department,
Guru Nanak Dev University,
Amritsar.

Light Load Detail

Street Light Details

S.No.	Lightfitting	Nos	Running Hrs for 12 month	Energy (kwh) for 12 month	Remarks
1	LED 60/70 watt	202	3650	47925	Replaced for Sodium 150 watt
2	LED 60 watt	95	3650	20805	New installed
3	LED 45 watt	133	3650	21845	Replaced for old and new installed
4	LED 25 watt	45	3650	4106	Replaced for FTL 40 Watt
5	FTL 1x40 watt	60	3650	8760	Old Fitting
6	Sodium 70 watt	220	3650	56210	Old Fitting

Incharge, Division IV
Construction Department,
Guru Nanak Dev University,
Amritsar.

Building Light Details

S.No.	Category	Light fitting	Power KW	Nos	Running Hrs for 12 month	Energy (kwh) for 12 month
1	Girl Hostel 1,2,3,4,	FTL 1x40 watt	100	2000	1248	124800
		LED 20 watt		1000		
2	Boy's Hostel 1, 2, 3	FTL 1x40 watt	100	2000	1248	124800
		LED 20 watt		1000		
3	Total Deptt.	FTL 1x40 watt	136.5	2500	2304	276480
		LED 20 watt		1000		
		Other Fitting 23 - 42 watt	15	500	2304	34560
4	Residential Area		135 / Per day	360 day Hrs		48600

Cooling Load Detail

AC Load Detail

S.No.	Category	Nos	Power KW	Running Hrs for 12 month	Energy (kwh) for 12 month
1	Ac - 2 Ton	64	192	792	152064
2	Ac - 1.5 Ton	658	1480.5	792	1172556
3	Ac - 1.5 Ton	400	900	1248	1123200
4	Ac - 1 Ton	5	750	792	5940

AC Plant Load Detail

S.No.	Plant capacity	Power KW	Running Hrs for 12 month	Energy (kwh) for 12 month
1	6 x 5.5 = 33 Ton	49	80	3920
2	11 x 3 = 33 Ton	49	80	3920
3	12 x 4 = 48 Ton	72	120	8640
4	16.5 x 10 = 165 Ton	247.5	40	9900

Water Cooler Detail

S.No.	Water Cooler 150 Lt	Power KW	Running Hrs for 12 month	Energy (kwh) for 12 month
1	182 Nos	273	360	98280

Desert Cooler

S.No.	Desert Cooler	Power KW	Running Hrs for 12 month	Energy (kwh) for 12 month
1	150 Nos	22.5	1152	25920

Refrigerator Detail

S.No.	Refrigerator 150/300 Lt	Power KW Per Day	Total Days	Energy (kwh) for 12 month
1	Deptt. 163 Nos	163	365	59495
2	Res:- 450 Nos	450	365	164250

Fan Load Detail

S.No.	Category	Nos	Power KW	Running Hrs for 12 month	Energy (kwh) for 12 month
1	Girl Hostel	1200	120	1456	174720
2	Boy's Hostel	1200	120	1456	174720
3	Residential Area	1000	100	1680	168000
4	Deptt	3000	300	1456	436800

Incharge Division IV
Construction Department,
Guru Nanak Dev University,
Amritsar

Waste water Treatment Plant

S.No.	Category	Power KW	Running Hrs for 12 month	Energy (kwh) for 12 month
1	Disposal Water Plant	122	3240	395280

Water Supply

S.No.	Category	Power KW	Running Hrs for 12 month	Energy (kwh) for 12 month
1	Water pumps 50hp x 5 nos 30 hp x 2 = 310 hp	228	3240	738720

Solar Water Heater Detail

S. No	Category	Capacity (Litre)
1	Boy's Hostel - 1	6500
2	Boy's Hostel - 2	3500
3	Girl's Hostel - 1	3500
4	Girl's Hostel - 2	6100
5	Girl's Hostel - 3	6000
	Total	**25600**

Annexure – VI

DG Details			
Rating (kVA)	No Of DG		
500 KvA	2		
380 KvA	2		
Total No of DG	HSD Consumption (Ltr)/Year 2017-18	HSD Consumption (Ltr)/Year 2018-19	HSD Consumption (Ltr)/Year 2019-20
4	27835	17450	12965

Annexure – VII

GURU NANAK DEV UNIVERSITY, AMRITSAR

(Established by the State Legislature Act No. 21 of 1969 and University with Potential for Excellence recognized by UGC)

OFFICE OF DEAN STUDENTS' WELFARE

No. 1443/DSW

Date 23-4-2021

Ref : Your email dated 20.04.2021 regarding LPG consumption in the hostels messes and canteens for the year 2017-18 to 2020-21.

With reference to your above said email, the LPG consumption in the hostels messes and canteens for the year 2017-18 to 2020-21 is as below:

LPG Cylinders consumed in Mess (Approx.)					
		2017-18	2018-19	2019-20	2020-21
1	Boys Hostel-1 (Mess No. 1)	625	625	625	185
2	Boys Hostel-1 (Mess No. 2)	625	625	625	465
3	Boys Hostel-2 (Mess No. 1)	550	590	700	200
4	Boys Hostel-2 (Mess No. 2)	750	800	830	240
5	Boys Hostel-3 (Mess cum Canteen)	360	540	900	175
6	Girls Hostel-1	660	660	495	225
7	Girls Hostel-2	605	605	530	225
8	Girls Hostel-3	650	650	585	180
9	Girls Hostel-4	730	690	520	341
	Total	**5555**	**5785**	**5810**	**2236**
LPG Cylinders consumed in Canteens(Approx.)					
1	Boys Hostel-1 (Canteen No. 1)	170	170	170	37
2	Boys Hostel-1 (Canteen No. 2)	170	170	170	110
3	Boys Hostel-2	350	335	370	64
4	Girls Hostel-1	86	86	54	15
5	Girls Hostel-2	180	132	72	8
6	Girls Hostel-3	49	120	80	4
7	Girls Hostel-4	No Canteen			
	Total	**1005**	**1013**	**916**	**238**

Lockdown was imposed in the Month of March 2020 so Canteens and Messes were closed from March 2020 to November 2020.
In the year 2017-18 Canteen Contractor of the Hostel No.4 had changed, so the information can not be given. Canteen of Girl Hostel-4 was closed from 2018-19 to 2020-21.

(Prof. Anish K. Dua)
Dean Students' Welfare

O.S.D. (Vice-Chancellor)


ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ
GURU NANAK DEV UNIVERSITY

Power Purchase Agreement

Azure Power Rooftop One Pvt. Ltd, New Delhi
and
Guru Nanak Dev University, Amritsar, Punjab

Prepared by:
Internal Quality Assurance Cell, Guru Nanak Dev University, Amritsar

SOLID WASTE MANAGEMENT

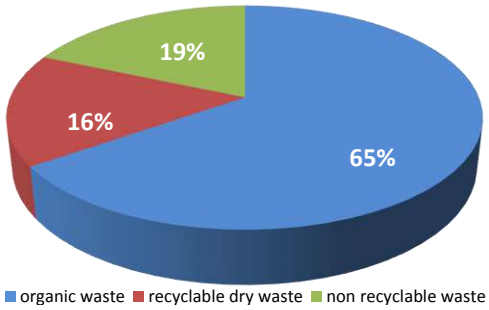
Guru Nanak Dev University
Amritsar

Preface

Guru Nanak Dev University Campus is tempts to be a zero waste campus in its region. Its solid waste is collected, segregated, and treated from its internal resources. The solid waste management concerns are reported for Internal Quality Assurance Cell, GNDU jointly by Dr. D. S. Sogi, Professor, Food Science Department and Dr. Kiran Sandhu, Associate Professor of Guru Ramdas School of Planning, GNDU. The report showcases the initiatives of the university with the aim to make the university a net zero waste campus.

1. The Context

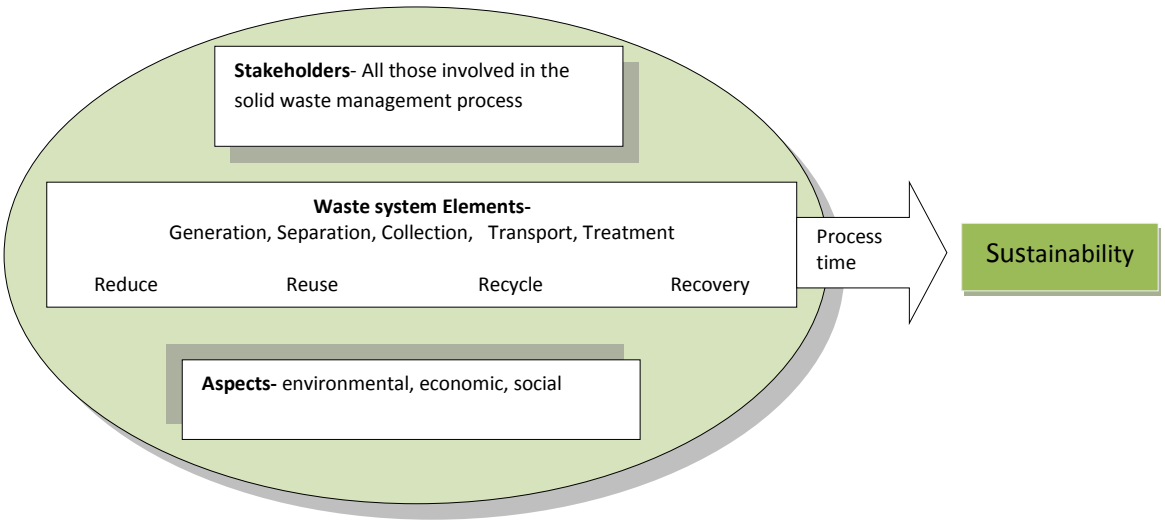
The University campus is spread over 500 acres land, divided into thirty seven academic departments, administrative, maintenance and commercial units and residential complexes comprising of University teaching and non- teaching staff and 5000 students. The solid waste generated from the campus amounts to about *400 Kgs daily*. Prior to the launch of the initiative, the solid waste was collected and disposed off without segregation in an unsanitary landfill site about five kms from the University. The practice was unsustainable and non-resourceful to say the least.



The adoption of the ISWM method has ensured a sea change wherein source segregation practices ensure that solid waste is collected in different types of the bins with colour code green, red and black. Green coloured bins are used to collect biodegradable waste, red bins are used to collect non-biodegradable waste whereas black bins are used for the collection of used masks.

2. Objective of the Practice

Guru Nanak Dev University is one of the pioneer higher education institutions in the country to have revolutionised and streamlined its waste management systems in accordance with the ideological principles of Integrated Sustainable Waste Management (ISWM) to move towards maximum landfill diversion and waste minimization at source. The concept of ISWM applied herein comprises of three dimensions, i.e. the stakeholders involved in waste management, such as the municipal workers, informal sector waste pickers, iterant waste buyers, waste dealers, wholesalers, recycling enterprises and end user industries. The second dimension pertains to the practical and technical elements of the waste management system based on the underlying principles of industrial ecology and life cycle analysis, emphasising waste prevention, reuse and recycling. The third aspect consists of sustainability aspects reflecting the framework that underlines the assessment of the waste management system.



Integrated Sustainable Waste Management Model (ISWM)

3. The Practice

In 2017, the University established the *Solid Liquid Waste Management Centre* to manage its waste as a resource and also provide advisory services to Amritsar Municipal Corporation for managing the city's waste efficiently. Since then the University has established a system that incorporates the ISWM model as the hallmark of its waste management architecture. The following are the unique features of the practice.

3.1. Biodegradable Waste Utilization

The following practices have been ensuring that organic waste material is managed in a manner to lead to creation of usable products and therefore contribute minimal to the waste stream that reaches the landfill site.


Composting Site and Biogas Unit

***3.1.a. Cooked Waste*:** It is a biodegradable waste which is produced mainly in boys and girls hostels. The leftover food is collected in a plastic drum. Dairy farmers visit the mess every day in the early morning and take away the waste to feed the dairy animals.

***3.1.b. Vermicomposting*:** One vermicomposting unit is being run at the SLRM Centre in a shed. Cow dung is procured from the local vendors and used to rear the earthworms. Once the earth worms become active, the uncooked waste collected from the hostel messes, Canteens and residential area is crushed in a grinder to reduce the size. The ground waste is fed to the earth worms by opening the raw and transferring the waste into the row followed by covering with the composting material. The ground waste takes about 8-10 days in summer to get completely decomposed.

***3.1.c. Microbial Composting*:** The garden waste and uncooked waste are decomposed under aerobic condition following Bengalore Model. Three layer system is adopted in which the first layer was of leaves from garden waste, second layer of ground uncooked waste and the third layer is of cow dung. Two pits 10ft x 12ft x 4ft have been dug wherein the first pit is filled by utilizing the uncooked waste and leaves as mentioned earlier and then the compost is transferred to the second pit. The compost is allowed to decompose in second pit for one month and is kept moist by sprinkling water regularly all the time. The compost is of dark brown colour without any off odour.

***3.1.d. Biogas Unit*:** One biogas plant has been designed to utilize the uncooked waste to produce energy. The design has been developed by calculating the amount of biogas required by a family of four persons. Currently the biogas plant is working on trial basis and will be fully functional soon.

3.2. Non-Biodegradable or Dry Waste Utilization

The dry waste comprising of paper, plastic, metal, etc. is stored in separate red coloured bins and collected by one tractor trolley with one driver and one helper. These dust bins have been installed in the entire campus. The collected waste is taken

to SLRM Centre where it is segregated into white paper, Newspaper, corrugated fibre board boxes, glass bottles, plastic bottles, metal, plastic film, etc. These items are sent to the recycling industry through private contractors.

Solid Liquid Resource Management Centre

4. Sanitary Napkins and Other Hospital Waste

The University Girls Hostels are equipped with sanitary pad dispensers and incinerators thereby completely eliminating this hazardous waste stream from the solid waste that can create immense health hazards at all levels of disposal from waste bins up to landfill sites. Currently two units of the dimensions 260x310x560 mm are installed per hostel with a capacity of 180 sanitary napkin burning/day. The incineration process is the most hygienic and safe methodology to handle this type of waste and University has earned the distinction of being the first institution in the region to have done so. Other hospital waste from the University's Health Centre and teaching departments is collected by a private bio-medical waste management company, Amritsar Envirocare Systems, Ibbankalan Village, Amritsar.

Sanitary Napkin Incinerators at Girls Hostels

5. Evidence of Success

It is a matter of immense pride to mention that the University campus stands at number one position among the most *Swachh Campus* out of the multispecialty public universities with large campuses and ranked second amongst all government universities as per the survey of Ministry of Human Resource Development, Government of India under the Swachh Campus Ranking in 2018 and 2019. The Solid Waste Management initiatives at the University intend to make it a zero waste campus besides serving as a model for other institutions and the city to emulate. As such, the initiatives have been highlighted in regional newspapers from time to time since 2017.

5.1. Environment Sustainability

At the heart of the solid waste management system in the University is environment sustainability underpinned by the initiatives to maximize the extraction of useful products from the waste. The biodegradable components are being effectively recycled into ecological products like organic manure and natural gas, both having a minimal environmental footprint and put to reuse, albeit in a different form. The dry non-biodegradables like paper, plastic and metals are sourced to specialized industrial units that convert them into usable products and bring them back as a part of the circular economy. Also the final disposables for land filling are minimal and the campus has achieved a substantial landfill diversion.

5.2. Economic Sustainability

Essentially, a system is economically sustainable if it is able to optimise costs, cover expenses and have a return on the investment or resources deployed. An income of Rs 1.15 lakh annually is generated through sale of dry recyclable waste with Rs 10.5 thousand/month generated through sale of plastics only. Biodegradable waste processing yields three quintals of organic manure per month which is utilized in the University's landscaping initiatives and leads to a cost saving of Rs 7 lakh annually which would otherwise be spent to buy fertilizers. The initial trial runs with the bio-gas plant have demonstrated that in the initial phase which starts in a month's time, ten families can be supplied with natural methane gas cylinders for kitchen utilization on a no profit no loss basis. The target is to produce 100 cylinders monthly thereafter. This shall be utilized in the hostel kitchens and is expected to significantly lower fuel costs. This model is totally zero waste and with minimal inputs in terms of investment and manpower, is generating viable results.

5.3. Social Sustainability

The system is proving to have immense social value by involving all stakeholders, i.e, the University authorities, the private contractor, the student and staff community, the waste workers involved in the Universities waste management process, thereby empowering and engaging them effectively. The participation of all these stakeholders actively has led to the University nearing its goal of zero waste campus in a short time span. In addition employment has been generated through the ISWM system wherein seven waste workers including two women have been given employment to sort, collect and transport waste. The salary of the employees is generated from the sale of dry recyclables, thus imposing no financial strain on the University's exchequer.

6. Problems Encountered and Resources Required

While it can be concluded that the ISWM model of waste management in the University has been successfully applied and bearing positive results on all fronts. Yet there are challenges that create bottlenecks towards achieving the zero waste targets. While composting units are functioning effectively, some technical obstacles have delayed the implementation of the bio gas plants. However the expert advice has been sought and it is envisaged that the system shall become fully operational in near future. Further, source segregation, despite the University's best efforts continues to pose a problem despite separate dustbins installed for the purpose. The University plans to launch a massive awareness campaign amongst its residents to engage the community with sensitization and awareness to get better results in waste segregation.

It is still the endeavour of the University to better the system to the extent that no waste leaves the campus and zero waste in the truest sense of the word becomes a reality and a model worthy of emulation.

Prepared by
Internal Quality Assurance Cell, Guru Nanak Dev University, Amritsar

BIOMEDICAL WASTE MANAGEMENT REPORT

Guru Nanak Dev University
Amritsar
2020-2021

Preface

Bio-Medical Waste (BMW) Management practices being followed at Guru Nanak Dev University Campus have been conceded for a period of five years i.e. 2016-2017 to 2020-2021. An audit of BMW has been carried out to assess the waste generated in aggregate and by its type and efforts made for its management as per the guidelines of Punjab Pollution Control Board. The report on BMW in the university is prepared by for Internal Quality Assurance Cell, GNDU by Dr. Harpreet Kaur, Chief Administrative Officer, Health Centre, GNDU. The BMW generated in yellow, red, blue and white categories is analyzed for the whole campus and the procedure being followed to handover the waste to the authorized firm is looked into to appreciate the guidelines being followed by the Health Centre of GNDU.

1. INTRODUCTION

Higher education institutions (HEIs) are the role models for the communities and society in number of ways. Their research, practices and deeds are adopted by the people, and governments to make policies, programmes, and missions to take the nations to higher peaks. The execution of innovative techniques and technologies within their own campuses help in improving the physical, social, cultural, economic, and environmental health of the nation. Hence, responsibilities have been fixed on the HEIs to act upon to achieve the sustainable development goals (SDGs) and their targets mandated to be achieved by 2030. Amongst the seventeen SDGs suggested by the United Nations, SDG 3 (Good Health and Wellbeing), SDG 6 (Clean Water and Sanitation) and SDG 12 (Ensure Sustainable Consumption and Production Patterns) focus on waste management practices one way or the other. They stress on implementing waste treatment technologies which do not create toxic residues or emissions in their own right. SDG 12 in particular targets on reducing pollution and health impacts through environmentally sound management (ESM) of all waste, including hospital waste. It stresses on sustainable healthcare waste management technologies such as biodigestion and autoclaving to make healthcare systems more resilient to disasters. The Bio-Medical Waste Management Rules, 2016 framed under Environment (Protection) Act, 1986 are mandated to be followed in the states of India.

2. Definition of Bio-Medical Waste (BMW)

Bio-Medical waste means any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining to or in the production or testing of biologicals (any preparation made from organisms or micro-organisms or a product of metabolism and biochemical reactions). Bio-Medical Waste Management Rules are applicable to all persons who generate, collect, receive, store, transport, treat, dispose or handle BMW in any form.

3. SOURCES OF BIO-MEDICAL WASTE

Bio-Medical waste is generated in medical and dental clinics, medical laboratories, animal houses etc. At Guru Nanak Dev University, apart from the Health Centre, other departments generating bio-medical waste are Department of Biotechnology, Zoology, Pharmaceutical Sciences, Human Genetics and Microbiology Waste generated can be in the form of hypodermic needles, scalpel blades, gloves, bandages, body fluids, human or animal tissue and organs, discarded medicine etc. According to WHO, about 85% of all waste generated by health care facilities/hospitals is general non-hazardous waste, about 10% is BMW and 5% is other waste such as radioactive or infections waste. It is important to realize that if all these types of waste are mixed together then the whole waste becomes harmful.

The key to minimize and effectively manage bio-medical waste is identification of waste and its segregation. The most appropriate way to do so is by sorting the waste based on colour. BMW has been classified into 4 categories i.e. Yellow, Red, White and Blue.

Category	Type of Bag Used	Type of Waste	Treatment/ Disposal Option
Yellow	Non Chlorinated plastic bags of yellow colour and of 50 micron	• Human anatomical waste • Animal anatomical waste • Soiled linen and beddings • Blood bags • Microbiology and medical laboratory waste • Discarded medicines and cytotoxic drugs to be disposed off in separate yellow bags with cytotoxic symbol.	Incineration or deep burial
Red	Non chlorinated plastic bag of red colour and of 50 micron (after cutting /mutilation)	Recyclable plastic waste including tubings, bottles, gloves, syringes without needles, urine bags, vaccutainers, I/V tubes and sets, catheters	Send for recycling after autoclaving or microwaving
White	Translucent, puncture and leak proof containers	Waste sharps including metals such as needles, blades, scalpels, syringes with fixed needles, burnt needles	Auto or dry heat sterilization followed by shredding or mutilation
Blue	Cardboard box with blue marking	Recyclable glass waste such as broken glass, medicine vials ampoules, contaminated glass	Disinfection or Autoclaving then sent for recycling

4. UNIVERSITY HEALTH CENTRE

The University Health Centre was established in 1973 as a primary health care facility. The mission of the Health Centre is to enhance the health and wellness of University students, faculty and staff by providing access to quality health services and ensuring their wellbeing. Health Centre provides clinical (supporting health and wellbeing through care for acute and ongoing diseases and injuries) as well as ancillary services like laboratory, radiology and pharmacy services to the University community apart from supporting educational and research activities as well.

4.1. Facilities Available

The Health Centre provides the following medical facilities.

- Medical OPD
- Dental OPD
- Sports Dentistry Clinic
- Ayurveda OPD
- Physiotherapy Centre

There are no charges for doctors' consultations. The radiological/ other investigations are done at very nominal rates. The University Health Centre provides services for Medical, Dental as well as Ayurvedic O.P.D. There is also a specialized sports dentistry clinic which provides mouth guards to the sports persons for prevention of dental injuries. Attached to the Health Centre is a well-equipped Physiotherapy Centre having trained physiotherapist. These facilities remain open Monday to Saturday and even on gazzetted/ declared holidays.

Emergency services including ambulance services are available 24x7. The doctors at Health Centre provide primary health care. For services not covered at Health Centre, referral services to Government and Multispecialty hospitals for specialized treatment/hospitalization are available. Twenty Nine hospitals are on empanelment with the University at CGHS rates.

Other in house facilities available at Health Centre are:

- Fully computerized digital Electrocardiograph (ECG)
- Digital X-ray
- Bone mineral density scan (DEXA Scan)
- Mammography
- Dental X-ray (RVG)
- Orthopantomogram
- Vacuum thermoforming machine (for making mouth guards)

All X-ray equipments are registered with Atomic Energy Regulatory Board (AERB), Government of India. The rooms with X-ray equipment are built as per AERB guidelines with Lead Sheets in the walls and door. Radiation safety devices (lead aprons, lead gloves, thyroid shield, Gonadal shield, lead screens, lead glass) are available. Staff associated with use of these are provided with Personal Radiation Monitoring Devices (TLD Badges) through BARC accredited lab.

In order to manage any casualty among girl students, Health Centre has set up a medical room in the Girls' Hostel and a staff nurse is available at the hostel from 8 pm to 8 am daily including on Sundays & holidays. The medical officers of Health Centre regularly inspect the messes and canteens in boys & girls hostels. The mess & canteens workers are periodically examined and screened for any communicable diseases.

The University Health Centre has set up a sample collection unit in collaboration with NABL accredited laboratory for providing quality lab facilities at special subsidized rates. Ultrasonography facility has been provided to the university patients at discounted/CGHS rates in collaboration with three leading diagnostic centres of the city. A Medical Committee is constituted to regularly access the working of health centre and recommend programs of the benefit of university students. An emergency number 70877-07052 has been started to facilitate the faculty staff and students in case of any medical emergency. This number is operational 24x7.

An isolation room has been set up at Health Centre to separate and restrict movement of persons who are not ill but believed to have been exposed to the infection for the purpose of preventing the transmission of the disease. Being committed to the health of the faculty, staff and students of Guru Nanak Dev University and following the procedure and guidelines issued by the Punjab Government a vaccination drive against COVID-19 was started on 01-04-2021 and is still continuing at University Health Centre, 6763 doses of Covishield and Covaxin have been administered to people aged 18 years and above till 28-08-2021.

4.2. Staff Structure

Following is the detail of the staff working in the Health Centre of the University.

Sr. No.	Name of Post	Number
1.	Medical Officer	3
2.	Medical Officer (Dental)	1
3.	Staff Nurse	3
4.	Dispenser cum Pharmacist	5
5.	Radiographer	1
6.	Multipurpose Health Worker	1
7.	Attendant	5
Other Supporting Staff		
1.	CCJDEO	1
2.	Driver for Ambulance	1
3.	Safai Karamchari	1

Ayurvedic Wing (Punjab Government)

Sr. No	Name of Post	Number
1.	Medical Officer	1
2.	Ayurvedic Pharmacist	1
3.	Trained Dai	1

5. BIO-MEDICAL WASTE MANAGEMENT IN GNDU

It is well known and documented that BMW is a potential health hazard to health care workers, public as well as flora and fauna of the area. Considering the inappropriate BMW management, the Ministry of Environment and Forests implemented certain rules. In accordance with these rules, it is the duty of everyone in a health care facility to take all the steps to ensure that the generated waste is handled without any adverse effect to human health and environment. Thus the main objectives of bio-medical waste management are:

i) To prevent transmission of diseases from patients to health workers and vice-versa.

ii) To prevent injury to health care worker while handling bio-medical waste.

iii) To prevent general exposure to harmful effects of toxic bio-medical waste.

Safe and effective management of bio-medical waste is not only a legal necessity but also a social responsibility. As per Bio-Medical Waste Management Rules, 2016, no hospital can establish on site treatment and disposal facility, if a service of common bio-medical treatment facility is available within a distance of 75 kilometer. Thus, BMW at Guru Nanak Dev University is outsourced to M/s. Amritsar Enviro Care (P) Ltd. for three years from the date of agreement i.e. April 1, 2020 (refer annexure I). AECS has setup a facility to collect, transport, treat and dispose off the BMW generated by the health care establishments at Ibban Kalan, Chhabal Road, Amritsar. AECS shall collect the BMW from the GNDU premises.

As per the agreement AECS is liable to meet are the rules and regulations stipulated by the Punjab Pollution Control Board (PPCB). Also, liability of violating the Environment (Protection) Act 1986 and the relevant rules made there under shall rest on AECS (Annexure II). AECS has been collecting the BMW of GNDU from 2011.

6. BIO-MEDICAL WASTE GENERATION

An account of last seven years starting from 2017, reveal that the GNDU health centre is producing little more than 500 kilograms per year BMW annually (refer figure 1). Thus, on average the university produces only 42 kilograms of BMW annually. In 2017, it was about 390 kilograms, which rose to about 510 kilograms in 2018 and remained at about 512 kilograms in 2019. Increasing footfall of patients may be attributed to the rising volume of BMW. The years

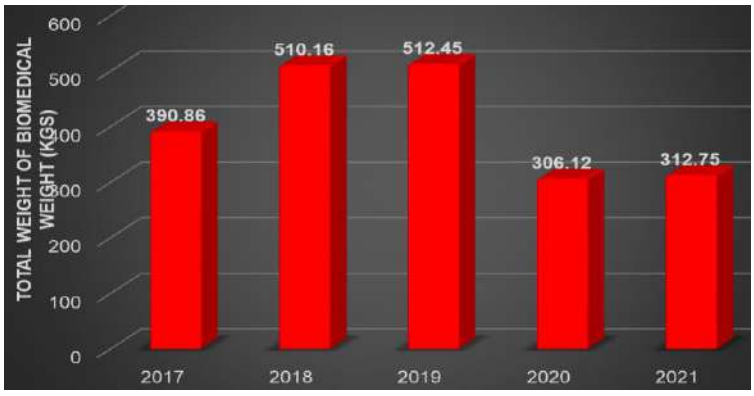


Figure 1: BMW Generation in GNDU

2020 and 2021 have been the COVID 19 effected years, Hence the patient footfall has also decreased in these years due to mandatory lockdowns. The BMW reduced to little more than 300 kilograms per year, about 25 kilograms annually. Therefore, the contribution of GNDU towards BMW is meager.

6.1. Bifurcation of Bio-Medical Waste

The BMW is collected in four types of bags viz., yellow, red, blue and white. The details of the bifurcated BMW generation by GNDU for the last five years (2017-2021) are described in annexure III. It is evident from figure 2 that the university has been generating cytotoxic waste to the tune of about 240 kilograms per year e.g. 2018 and 2019. Recyclable plastic waste such as tubings, bottles, gloves, syringes without needles, urine bags, vaccutainers, I/V tubes and sets, catheters, etc. constitute the next higher volume of BMW during the same years. Subsequent to 2019, COVID-19 conditions have reduced the volume of cytotoxic and recyclable plastic waste resulting from lowered patient footfall. But this phase appears to be short lived, to state that the cytotoxic waste and recyclable plastic waste will be about 240 kilograms and 180-200 kilograms per year respectively. Recyclable glass waste such as broken glass, medicine vials ampoules, contaminated glass, etc. constitute about 65-90 kilograms weight under normal conditions.

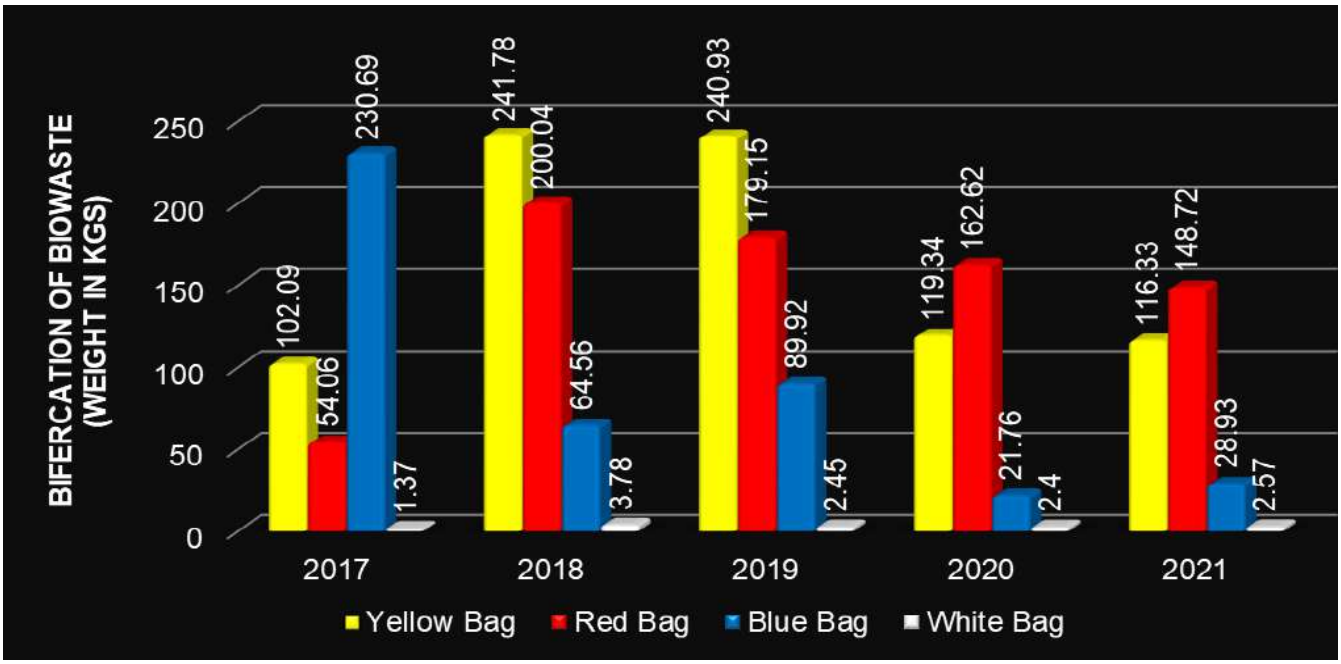


Figure 2: Bifurcation of BMW Generation at GNDU

Baring 2017, recyclable glass waste constitutes about 39-47 percent share of the total BMW in the last five years (refer figure 3). Recyclable plastic waste and recyclable glass waste share 35-53 percent and 7-18 percent of the total BMW of the university. The share of waste sharps (white bag) including metals like needles, blades, scalpels, syringes with fixed needles, burnt needles, etc. has a meagre share (largely less than 1 percent) in the total BMW in the past five years.

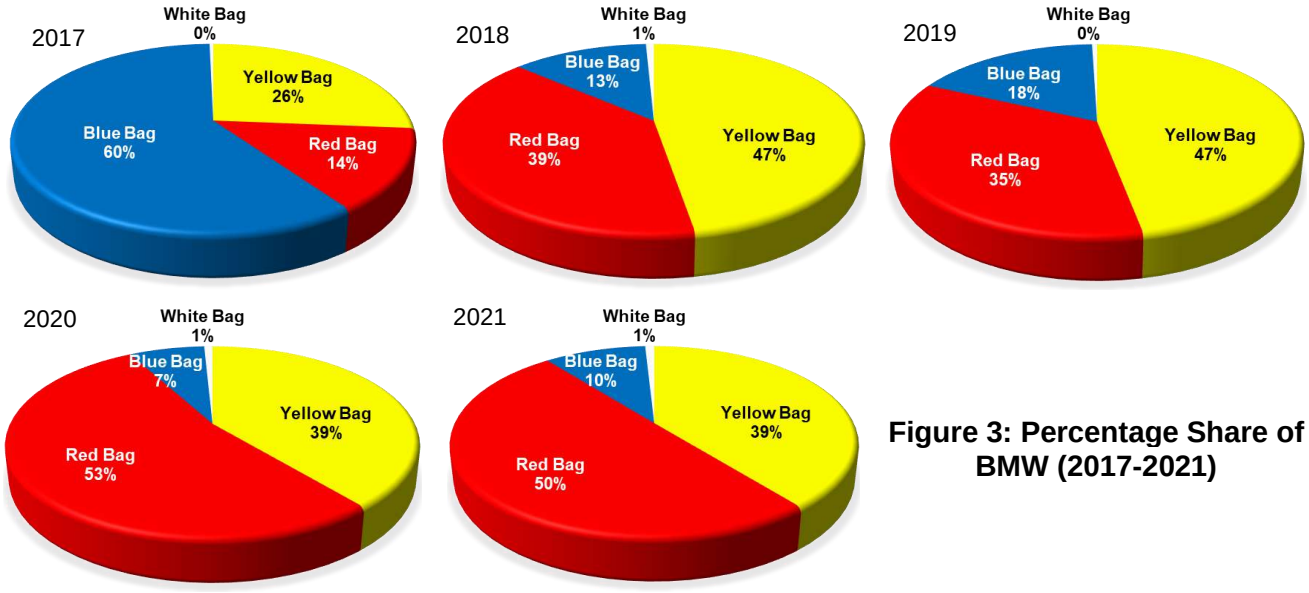


Figure 3: Percentage Share of BMW (2017-2021)

The BMW generated at the GNDU Health Centre is packed in the respective yellow, red, blue and white bags and collected by AECS to be transported to the treatment plant at Chhabal Road, Amritsar.

7. BIO-MEDICAL WASTE HANDLING AND TRANSPORTATION

The BMW is temporarily stored at the central storage area of University Health Centre and from there it is sent to the site for final disposal by the AECS. It is ensured that the bags/containers are properly sealed and labeled. Bags are not filled completely so that they can be picked up by their neck for further handling. After removing the bags, the containers including the lid is cleaned/ disinfected. No untreated BMW is kept stored beyond a period of 48 hours. Transportation from health care facility to the site of final disposal is carried out in a closed motor vehicle to prevent spillage of waste on the way.

8. DISPOSAL OF BIO-MEDICAL WASTE

Some methods of disposal of BMW are deep burial, autoclave and microwave treatment, shredding, land disposal (sanitary and secured landfills), and incineration.

9. CONCLUSIONS

The segregation and handling/collection of BMW is done by Staff Nurse and Safai Karamcharis while the transportation and final disposal (or recycling) is carried out by AECS. Furthermore, it is ensured that the staff handling BMW at the University Health Centre wears protective clothing and gloves/ masks while doing so and is immunized against tetanus and Hepatitis B. The University Health Centre believes that while proper collection and segregation of bio-medical waste are important, at the same time the quantity of waste generated is equally important. A lesser amount of BMW means a lesser burden on waste disposal work, cost saving and a more efficient waste disposal system. Hence, healthcare providers are encouraged and motivated to reduce the waste generation in their day to day work, discard waste safely and save our environment.

Annexure I

52061

AGREEMENT

The agreement entered into the 1st day of April of the year 2020 Exp. Date 31st March 2023

BETWEEN

M/S. Amritsar Environcare Systems (P) Ltd., (Formerly Amritsar Healthcare Systems) Village Iban Kalan, Chahal Road, Amritsar (hereinafter called As AECS (P) Ltd represented by Dr. Inderpal Singh Pasricha, Contact No. 0183-5065311, Email id- aecs2004@rediffmail.com

Name of Hospital & Address Guru Nanak Dev University Health Centre & Allied Teaching Departments Incinerating Bio-Medical Waste AND Amritsar

(hereinafter referred to as the GENERATOR) represented by Mr. Prof. Karamjeet S. Kahlon (Reg.)

Tel. /Mob No. 9872456834 E-Mail reg_gndu@yahoo.com

Whereas AECS (P) Ltd. has setup a common facility at Chhabal Road, Village Iban Kallan, Amritsar and has setup a unit of this facility for collection, transportation, treatment and disposal of Bio-Medical Wastes (hereinafter called as BMW) generated by Health care Establishments (HCEs - Hospitals, Nursing Homes, Blood Banks, OPD Clinics, Pathological Laboratories, Diagnostic Centres, Medicine Manufacture centre, Medical Stores, Beauty Saloons etc.)

Whereas AECS (P) Ltd. offers to provide service to the GENERATOR on a user pay principle for collection Transportation Treatment and Disposal of BMW at the Rate of Rs. 3000/- Per month (including transportation charges) per bed per day with a security advance equivalent to the payment for 60 days bag charges extra.

Whereas AECS (P) Ltd. undertakes the liability of collection, transportation, treatment and disposal of BMW, the GENERATOR shall undertake to adhere to this contract of service by AECS (P) Ltd. for a minimum period of five years from the agreement date.

Where the GENERATOR is a Hospital and agrees to avail the services being provided by AECS (P) Ltd. with the terms & conditions as listed on succeeding paras:-

RESPONSIBILITIES OF AECSPL

1. AECS (P) Ltd. shall meet all the rules and regulations stipulate by the PPCB and the GENERATOR shall not be liable for any improper handling and management.

2. AECS (P) Ltd. alone is liable for any violation of the Environment (Protection) Act 1986 and the relevant rules made there under, collection of BMW from the Generator unit as per the agreement terms & conditions.

3. AECS (P) Ltd. shall collect BMW from the Generator premises.

4. In case AECS (P) Ltd. vehicle fails to collect the BMW within 24 hours of the designated time (24 hours) due to any reason. The GENERATOR shall inform the AECS (P) Ltd. office at Amritsar, who will ensure to strictly collect the BMW within the next 24 hours. AECS (P) Ltd. shall be solely responsible for the consequences, if any, in this regard. AECS (P) Ltd. office shall maintain a register for such complaints and allot the complaint number to the GENERATOR.

5. Other complaints, if any, shall also be made to AECS (P) Ltd., Amritsar office by the GENERATOR. AECS (P) Ltd. promises to attend to all such complaints, within the shortest possible time.

Amritsar Environcare Systems (P) Ltd.

6. AECS (P) Ltd. shall collect the segregated bio-medical waste from the identified common waste collection site in the premises of GENERATOR.

7. AECS (P) Ltd. shall provide assistance to finalize the pick-up location to the GENERATOR.

8. AECS (P) Ltd. shall transport the segregated waste in closed container vehicle to its treatment plant.

9. If the GENERATOR desires, the initial training about segregation of BMW in colour coded plastic bags and method of collection of BMW, shall be provided by AECS (P) Ltd. at no extra cost.

10. AECS (P) Ltd. shall schedule the timings the collecting the waste in consultation with the GENERATOR.

11. AECS (P) Ltd. will not be liable for Environment (Protection) Act 1986 or any similar regulations/norms set up by PPCB, Government Bodies, in the event the GENERATOR violates any of the terms and conditions.

12. AECS (P) Ltd. shall be responsible for appropriate treatment and shredding of disinfected waste at the centralized facility as per Schedule-I of the BMW (M&H) Rules 2016.

13. AECS (P) Ltd. shall also undertake testing of treated waste to ensure safety to the environment.

14. AECS (P) Ltd. shall be responsible for the disposal of treatment waste into secured landfills or in recycling plants as applicable.

RESPONSIBILITIES OF THE GENERATOR

1. The GENERATOR shall segregate the waste at the point of generation in accordance with the BMW (M&H) Rules 2016 and in compliance with the standards prescribed there under.
2. The GENERATOR shall collect the segregate BMW in plastic bags as stipulated by Pollution Control Board (PCB) Norms.
3. The bags shall be procured by the GENERATOR at its own cost either through AECS (P) Ltd. or through PPCB approved vendor.
4. The bags used for collecting solid materials, placenta, emputated body parts etc., (required to be incinerated) shall be non-chloriated plastic bags.
5. All the bags shall be sealed tightly by the GENERATOR and AECS (P) Ltd. will collect the sealed bags only at a secured designated point in the premises of the GENERATOR.
6. The GENERATOR shall disinfect the sharps and mutilate them and hand them over in Puncture Proof Containers to AECS (P) Ltd.
7. The GENERATOR shall take all steps to ensure that the waste is handled without adverse effects to human health and environment.
8. The GENERATOR shall furnish annual report regarding generation, collection, storage, transportation and disposal of Bio-Medical wastes in the prescribed format to Punjab Pollution Central Board.
9. The GENARATOR shall be solely responsible for the number of beds being to AECS (P) Ltd. which must be same for which the authorization is proposed to be got from Punjab Pollution Control Board. The GENARATOR shall inform AECS (P) Ltd. and about any such change in the number of beds. The total no. of beds are ( ) at present.

Harpreet Kaur

TERMS OF MEMBERSHIP & PAYMENT

1. The GENERATOR shall pay a Membership Registration Fee of Rs.2500/- for five year & renewal of agreement fee is Rs.500/- for one year, which are non-refundable.
2. The security advance of 60 days is refundable/adjustable upon completion of this agreement against BMW collections.
3. The GENERATOR shall pay the monthly charges of cost of disposal by 10th of every month without fail. Payments that are not made by the 10th of every month shall be charged a late fees @ Rs.50/- a day upto 22nd of the month.
4. AECS (P) Ltd. shall stop collecting BMW from GENERATOR if payments are not received by 22nd of the month.
5. Renewal of service shall be subject to a charge of Rs.500/- in addition to the amount due including the fine.
6. All payments shall be made in favour of AECS (P) Ltd. in the form of DD or A/c. payee cheques. All bounced cheques shall be charged at Rs.100/- extra in addition to the actual bank charges.
7. The GERERATOR is liable to forfeit his advance deposit, in the event of him violating the terms and conditions of this agreement.
8. The Service Charges increased by 7% every year without any prior intimation.
9. AECS (P) Ltd. has right to change the service charges time to time according to diesel prices and after Punjab Pollution Control Board, Patiala & DHS orders for revision of rates.
10. These rates are subject to mutually reviewable during this agreement period.
11. All disputes are subject to Amritsar Jurisdiction only.
12. New HCF's must obtain authorization under Bio Medical Waste Rules, 2016 from Punjab Pollution Control Board within 3 months from the date of signing agreement. If fails this agreement stands cancelled and we stop our Bio Medical Waste collection services immediately by giving notice and intimation to Punjab Pollution Control Board.

Witnesses: 1. Incharge Procurement & Maintenance Health Centre, GNDU, Amritsar

2. Amritsar

Director

Registrar
Guru Nanak Dev University
Amritsar

Annexure II

PUNJAB POLLUTION CONTROL BOARD

Regional Office, Plot no. 164, Focal Point, Mehta Road, Amritsar

www.ppcb.gov.in

Office Dispatch No : **Registered/Speed Post** **Date:**

Registration ID: *H14ASR2005659* **Application No :** *13841476*

To,

Karanjeet Singh Kahlon,
Guru Nanak Dev University
Amritsar i, Amritsar, 143005

Subject: **Renewal of Authorization under Bio-Medical Waste Management Rules, 2016 framed under Environment (Protection) Act, 1986 for [Generation, Collection, Storage] of Bio-Medical Waste.**

With reference to your application for obtaining Authorization under Bio-Medical Waste Management Rules, 2016 framed under Environment (Protection) Act, 1986, you are, hereby authorised for handling/ managing Bio-Medical Waste under Bio-Medical Waste Management Rules, 2016 as per the details specified in this authorization.

1. Particulars of Applicant (Occupier/Operator)

Name of Applicant (Occupier/Operator)	*Karanjeet Singh Kahlon*
Designation :	*Registrar*
Correspondent Address :	*Karanjeet Singh Kahlon, Guru Nanak Dev University Amritsar i, Amritsar, 143005*
Mobile Number :	*9872456834*
Landline Number :	*0183-2258855*
Fax Number :	*0183-2258819*
Email-ID :	*reg_gndu@yahoo.com*

2. Particulars of HCF/CBWTF

Name of HCF/CBWTF	*University health centre (hcf)*
Address of HCF/CBWTF premises	*University health centre (hcf) Guru nanak dev university*
Mobile Number :	*9872456834*
Facility Type and Subtype	*HCF (Govt Hospital(Bedded))*
Ownership	*Individual*
No. of Beds (for HCF)	*10.0*
No. of HCF covered(for CBWTFs)	-
No. of Beds covered	-
No of Beds	*10*
Area and Distance Covered by CBWTF	-
Mode of Transportation of BMW	*Common Facility Vehicle*

3. Particulars of Authorization

Authorization No.	*BMW/Renewal/ASR/2020/13841476*
Previous Authorization No	*BMW/Renewal/ASR/2020/13136088*
Previous Authorization Date of Issue	*17/08/2020*
Previous Authorization Date of Expiry	*30/09/2020*
Date of Issue	*26/10/2020*
Date of Expiry	*30/06/2023*
Authorization Type	*Renewal*
Activities authorized	*(Generation, Collection, Storage)*

4. Particulars of Bio-Medical Waste

Waste category	Quantity permitted for handling	Unit
Yellow	*0.66*	*kg/day*
Red	*0.49*	*kg/day*
White(Translucent)	*0.1*	*kg/day*
Blue	*0.24*	*kg/day*

5. The HCE/CBWTF shall discharge its effluent after treatment as prescribed under the Rules.

6. The Authorization is subject to the Terms and Conditions as specified in this Authorization and also to such conditions as may be specified in the rules for the time being in force under the Environment (Protection) Act, 1986.

Environmental Engineer
For & on behalf
of
(Punjab Pollution Control Board)

Endst. No.: **Dated:**

A copy of the above is forwarded to the following for information and necessary action please:

Zonal Office

Environmental Engineer
For & on behalf
of
(Punjab Pollution Control Board)

TERMS AND CONDITIONS

A. GENERAL CONDITIONS

1. This authorization is issued for _____ number of beds. For any increase in number of beds, the applicant shall obtain prior permission of the Board.
2. The Medical Institution / Health Care Facility shall apply for the renewal of authorization at least 2 months before the expiry of this authorization.
3. The Medical Institution / Health Care Facility shall comply with the provisions of the Environment (Protection) Act, 1986 as amended from time to time and the rules made there under.
4. The authorization and all relevant records shall be produced for inspection on the request of an officer of prescribed authority.
5. The HCF shall take all necessary steps to ensure that bio-medical waste is handled without any adverse effect to human health and the environment and in accordance with these rules;
6. The HCF shall make a provision within the premises for a safe, ventilated and secured location for storage of segregated biomedical waste in colored bags or containers in the manner as specified in Schedule I, to ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals and the bio-medical waste from such place or premises shall be directly transported in the manner as prescribed in these rules to the common bio-medical waste treatment facility or for the appropriate treatment and disposal, as the case may be, in the manner as prescribed in Schedule I.
7. The HCF shall pre-treat the laboratory waste, microbiological waste, blood samples and blood bags through autoclaving/microwaving and then sent to the common bio-medical waste treatment facility for final disposal. The HCF shall maintain a logbook of operation of Autoclave.
8. The HCF shall phase out use of chlorinated plastic bags, gloves and blood bags as mentioned in the Rules;
9. Incase the HCF purchase color coded bag from open market, it shall get the testing certificate from CIPET Lab, Amritsar regarding absence of chlorinated material in it. However, if it is procured from CBWTF operator, the HCF shall obtain the test certificate from CBWTF operator.
10. The HCF shall dispose of general waste other than bio-medical waste in green bin.
11. The HCF shall not dispose bio-medical waste with municipal solid waste;
12. The HCF shall provide training to all its health care workers and others, involved in handling of bio medical waste at the time of induction and thereafter at least once every year and the details of training programmes conducted, number of personnel trained and number of personnel not undergone any training shall be provided in the Annual Report;
13. The HCF shall immunise all its health care workers and others, involved in handling of bio-medical waste for protection against diseases including Hepatitis B and Tetanus that are likely to be transmitted by handling of bio-medical waste, in the manner as prescribed in the National Immunisation Policy or the guidelines of the Ministry of Health and Family Welfare issued from time to time;
14. The HCF shall ensure occupational safety of all its health care workers and others involved in handling of biomedical waste by providing appropriate and adequate personal protective equipments;
15. The HCF shall conduct health check up at the time of induction and at least once in a year for all its health care workers and others involved in handling of bio- medical waste and maintain the records for the same;
16. The HCF shall ensure segregation of liquid chemical waste at source and ensure pre-treatment or neutralisation prior to mixing with other effluent generated from health care facilities;
17. The HCF shall ensure treatment and disposal of liquid waste in accordance with the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974).
18. The HCF shall obtain consents under the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981.
19. The HCF shall maintain and update on day to day basis the bio-medical waste management register and display the monthly record on its website according to the bio-medical waste generated in terms of category and colour coding as specified in Schedule I. All the record shall be subject to inspection and verification by the Prescribed Authority /authorized person at any time. The record shall be maintained for a period of 5 years.
20. The HCF shall report major accidents including accidents caused by fire hazards, blasts during handling of biomedical waste and the remedial action taken and the records relevant thereto, (including nil report) in Form I to the prescribed authority within 24 hours and also along with the annual report;.

21. The HCF shall submit Annual Report in Form-IV as per Rule 13 by 30th June every year to the Board. The HCF shall make available the annual report on its web-site and all the health care facilities shall make own website within two years w.e.f 28.03.2016.

22. The HCF shall ensure that Untreated human anatomical waste, animal anatomical waste, soiled waste and, biotechnology waste shall not be stored beyond a period of forty (48) eight hours: Provided that in case for any reason it becomes necessary to store such waste beyond such a period, the occupier shall take appropriate measures to ensure that the waste does not adversely affect human health and the environment and inform the prescribed authority along with the reasons for doing so.

23. The HCF shall inform the prescribed authority immediately in case the operator of a facility does not collect the bio-medical waste within the intended time or as per the agreed time;

24. The HCF shall establish a system to review and monitor the activities related to bio-medical waste management, either through an existing committee or by forming a new committee and the Committee shall meet once in every six months and the record of the minutes of the meetings of this committee shall be submitted along with the annual report to the prescribed authority and the healthcare establishments having less than thirty beds shall designate a qualified person to review and monitor the activities relating to bio-medical waste management within that establishment and submit the annual report;

25. The occupier of the HCF shall maintain proper housekeeping in the premises where the bio-medical wastes are handled.

26. The HCF is required to set up system/equipments for requisite segregation, collection, storage and pre-treatment of bio-medical waste in conformance to the provisions of Bio-Medical Waste (Management) Rules, 2016.

27. The Containers/ Bags used for segregation and disposal of waste shall be labeled in accordance with schedule- IV (Part-A).

28. The HCF shall segregate the bio-medical waste collected in the container bags at the point of generation in accordance with Schedule-I prior to storage, transportation, treatment and disposal.

29. The HCF shall hand-over segregated waste as per Schedule-I to common bio-medical waste treatment facility for treatment, processing and final disposal.

30. The HCF shall paste Bar-Code Stickers on respective color coded bags, puncture proof containers and cardboard box before disposal to CBWTF.

31. The HCF shall ensure treatment and disposal of waste in accordance with Schedule I and in compliance with the standards provided in Schedule-II.

32. The HCF shall phase-out use of mercury based instruments. The handling and disposal of all mercury waste and lead waste shall be in accordance with the respective rules and regulations.

33. The occupier of the HCF will be liable for action under section 5 and section 15 of the Environment (Protection) Act, 1986, incase of any violation.

34. The HCF shall comply with the standards and specifications as per Bio-Medical Waste Management Rules, 2016.

35. The HCF shall give its bio-medical waste only to the authorized area common bio-medical waste treatment facility who has valid authorization of the prescribed authority.

36. The HCF will have to make its own arrangement afresh in case the authorization of the common facility to whom it has entered a MOU is revoked, by the Prescribed Authority.

37. The occupier of the HCF shall not change or alter either the quality or the quantity or the rate of discharge of liquid/emission or temperature or the route of discharge without prior written permission from the Board.

38. The occupier of the HCF, its heirs, legal representatives etc., shall have no claim whatsoever to the continuation or renewal of this authorization after the expiry of the authorization.

39. The authorized person shall intimate Board prior to closing down the facility.

40. The HCF shall not rent, sell, transfer or otherwise transport the bio-medical waste without prior permission from the Board.

41. Any unauthorized change in personnel/equipment or working conditions as mentioned in the application by the person authorized shall constitute a breach of this authorization.

42. The Board reserves the right to review, impose additional condition or conditions, revoke, change or alter the terms and conditions of the authorization without any prior notice.

B. SPECIAL CONDITIONS

1. The HCF will renew its agreement time to time made with Common Bio Medical Waste Treatment Facility well before its expiry and submit the copy of same in this office.

Environmental Engineer
For & on behalf
of
(Punjab Pollution Control Board)

Annexure III

Name: Guru Nanak Dev University Health Centre |Sap Id:| Hno:87844| Vehicle: Amritsar 1

Plant-Amritsar Envirocare Systems |Period: 01-2017 : 12-2017 |Hospital Id:87844| Bed Capacity:10| Town: Amritsar

	Yellow Bags		Red Bags		Blue Mark Box		Whites		Cytotoxic Bags		Covid Yellow Bags		Total	
Month	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**
Jan-17	6	16.03	8	8.47	0	0	0	0	0	0	0	0	14	24.5
Feb-17	8	11.17	11	10.28	2	7.24	1	0.41	0	0	0	0	22	29.09
Mar-17	8	7.74	17	50.69	0	0	1	0.82	0	0	0	0	26	59.24
Apr-17	5	14.75	20	57.6	2	1.6	0	0	0	0	0	0	27	51.67
May-17	3	1.22	1	8.72	22	40.66	0	0	1	1.58	1	1.07	28	53.25
Jun-17	4	15.09	2	9.14	12	17.4	0	0	0	0	0	0	18	41.63
Jul-17	8	26.75	0	0	14	21.48	0	0	0	0	0	0	22	48.23
Aug-17	4	8.29	1	3.19	20	31	1	0.37	0	0	0	0	26	42.84
Sep-17	11	21.43	3	14.35	26	42.54	0	0	0	0	0	0	40	78.31
Oct-17	5	9.26	0	0	12	13.31	1	0.68	0	0	0	0	18	23.25
Nov-17	4	17.86	1	13.74	23	37.86	0	0	0	0	0	0	28	69.46
Dec-17	1	1.3	1	4.92	18	24.84	1	0.32	0	0	0	0	21	31.38
Total	**41**	**102.09**	**9**	**54.06**	**149**	**230.69**	**3**	**1.37**	**1**	**1.58**	**1**	**1.07**	**204**	**390.86**

Name: Guru Nanak Dev University Health Centre |Sap Id:|Hno:87844|Vehicle:Amritsar 1

Plant-Amritsar Envirocare Systems |Period: 01-2017 : 12-2017|Hospital Id:87844|Bed Capacity:0|Town:Amritsar

	Yellow Bags		Red Bags		Blue Mark Box		Whites		Other Bags		Total	
Month	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**
Jan-18	8	27.4	9	17.94	0	0	0	0	0	0	17	45.34
Feb-18	10	16.16	12	14.73	0	0	0	0	0	0	22	30.89
Mar-18	8	6.55	11	17.25	0	0	1	0.24	0	0	20	24.04
Apr-18	7	23.11	12	13	2	12.97	0	0	0	0	21	49.08
May-18	11	51.44	12	13.52	3	15.55	0	0	0	0	26	80.51
Jun-18	7	38.21	17	17.57	0	0	2	0.45	0	0	26	56.23
Jul-18	8	8.02	22	45.74	2	15.52	3	2.59	0	0	35	71.87
Aug-18	2	8.4	4	4.11	1	4.97	0	0	0	0	7	17.48
Sep-18	2	22.37	4	22.75	1	5.13	0	0	0	0	7	50.25
Oct-18	5	17.19	6	10.19	1	10.42	2	0.38	0	0	14	38.18
Nov-18	6	3.93	7	7.46	0	0	1	0.12	0	0	14	11.51
Dec-18	6	19	7	15.78	0	0	0	0	0	0	13	34.78
Total	**80**	**241.78**	**123**	**200.04**	**10**	**64.56**	**9**	**3.78**	**0**	**0**	**222**	**510.16**

Name: Guru Nanak Dev University Health Centre |Sap Id:|Hno:87844|Vehicle:Amritsar 1

Plant-Amritsar Envirocare Systems| Period: 01-2019 : 12-2019 |Hospital Id:87844| Bed Capacity:0|Town:Amritsar

	Yellow Bags		Red Bags		Blue Mark Box		Whites		Cytotoxic Bags		Covid Yellow Bags		Total	
Month	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**
Jan-19	4	11.5	4	4.42	2	20.81	0	0	0	0	0	0	10	36.73
Feb-19	7	19.9	7	23.41	0	0	0	0	0	0	0	0	14	43.31
Mar-19	12	34.11	12	14.33	3	12.26	0	0	0	0	0	0	27	60.7
Apr-19	11	37.62	9	8.84	1	3.07	1	0.23	0	0	0	0	22	49.76
May-19	9	32.4	11	10.22	1	4.65	0	0	0	0	0	0	21	47.27
Jun-19	9	24.3	13	14.51	0	0	1	0.28	0	0	0	0	23	39.09
Jul-19	6	15.02	7	5.17	1	5.93	0	0	0	0	0	0	14	26.12
Aug-19	4	22.44	17	66.56	2	11.63	0	0	0	0	0	0	23	100.63
Sep-19	5	16.34	7	10.18	2	20.12	1	0.87	0	0	0	0	15	47.51
Oct-19	3	1.94	4	4.26	1	6.16	0	0	0	0	0	0	8	12.36
Nov-19	4	18.75	4	4.51	0	0	2	1.07	0	0	0	0	10	24.33
Dec-19	3	6.61	4	12.74	1	5.29	0	0	0	0	0	0	8	24.64
Total	**77**	**240.93**	**99**	**179.15**	**14**	**89.92**	**5**	**2.45**	**0**	**0**	**0**	**0**	**195**	**512.45**

Name: Guru Nanak Dev University Health Centre |Sap Id:|Hno:87844|Vehicle:Amritsar 1

Plant-Amritsar Envirocare Systems | Period: 01-01-2020 : 31-01-2020| Hospital Id:87844| Bed Capacity:0| Town: Amritsar

	Yellow Bags		Red Bags		Blue Mark Box		White Bags		Cytotoxic Bags		Covid Yellow Bags		Total	
Month	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**
Jan-19	3	10.52	2	2.01	0	0	1	1.06	0	0	0	0	6	13.59
Feb-19	1	0.45	11	44.73	3	6.08	3	1.34	0	0	0	0	18	52.6
Mar-19	3	15.04	2	3.74	0	0	0	0	0	0	0	0	5	18.78
Apr-19	4	21.95	1	2.75	0	0	0	0	0	0	0	0	5	24.7
May-19	0	0.00	0	0	1	5.94	0	0	0	0	0	0	1	5.94
Jun-19	5	2.99	4	4.02	0	0	0	0	0	0	0	0	9	7.01
Jul-19	5	4.36	13	23.98	1	4.2	0	0	0	0	0	0	19	32.54
Aug-19	2	1.2	0	0	0	0	0	0	0	0	0	0	2	1.2
Sep-19	4	34.6	11	17.49	0	0	0	0	0	0	0	0	15	52.09
Oct-19	3	3.95	30	47.17	1	5.54	0	0	0	0	0	0	34	56.66
Nov-19	6	22.03	2	1.11	0	0	0	0	0	0	0	0	8	23.14
Dec-19	4	2.25	4	15.62	0	0	0	0	0	0	0	0	8	17.87
Total	**40**	**119.34**	**80**	**162.62**	**6**	**21.76**	**4**	**2.4**	**0**	**0**	**0**	**0**	**130**	**306.12**

Name: Guru Nanak Dev University Health Centre|Sap Id:|Hno:87844|Vehicle:Amritsar 1

Plant-Amritsar Envirocare Systems Period: 01-01-2021 : 31-08-2021|Hospital Id:87844|Bed Capacity:0|Town:Amritsar

	Yellow Bags		Red Bags		Blue Mark Box		White Bags		Cytotoxic Bags		Covid Yellow Bags		Total	
Month	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**	**Count**	**Weight**
Jan-19	4	16.41	3	4.13	2	10.23	0	0	0	0	0	0	9	30.77
Feb-19	4	15.85	8	44.39	3	15.56	0	0	0	0	0	0	15	75.8
Mar-19	5	32.4	11	21.34	0	0	0	0	0	0	0	0	16	53.74
Apr-19	4	14.87	4	20.68	0	0	1	2.57	0	0	0	0	9	38.12
May-19	3	2.71	5	6.4	1	3.14	0	0	0	0	9	16.2	18	28.45
Jun-19	4	18.97	4	26.22	0	0	0	0	0	0	0	0	8	45.19
Jul-19	2	3.05	5	11.49	0	0	0	0	0	0	0	0	7	14.54
Aug-19	5	12.07	6	14.07	0	0	0	0	0	0	0	0	11	26.14
Total	**31**	**116.33**	**46**	**148.72**	**6**	**28.93**	**1**	**2.57**	**0**	**0**	**9**	**16.2**	**93**	**312.75**


CAUTION
BIOHAZARD


BIOHAZARD
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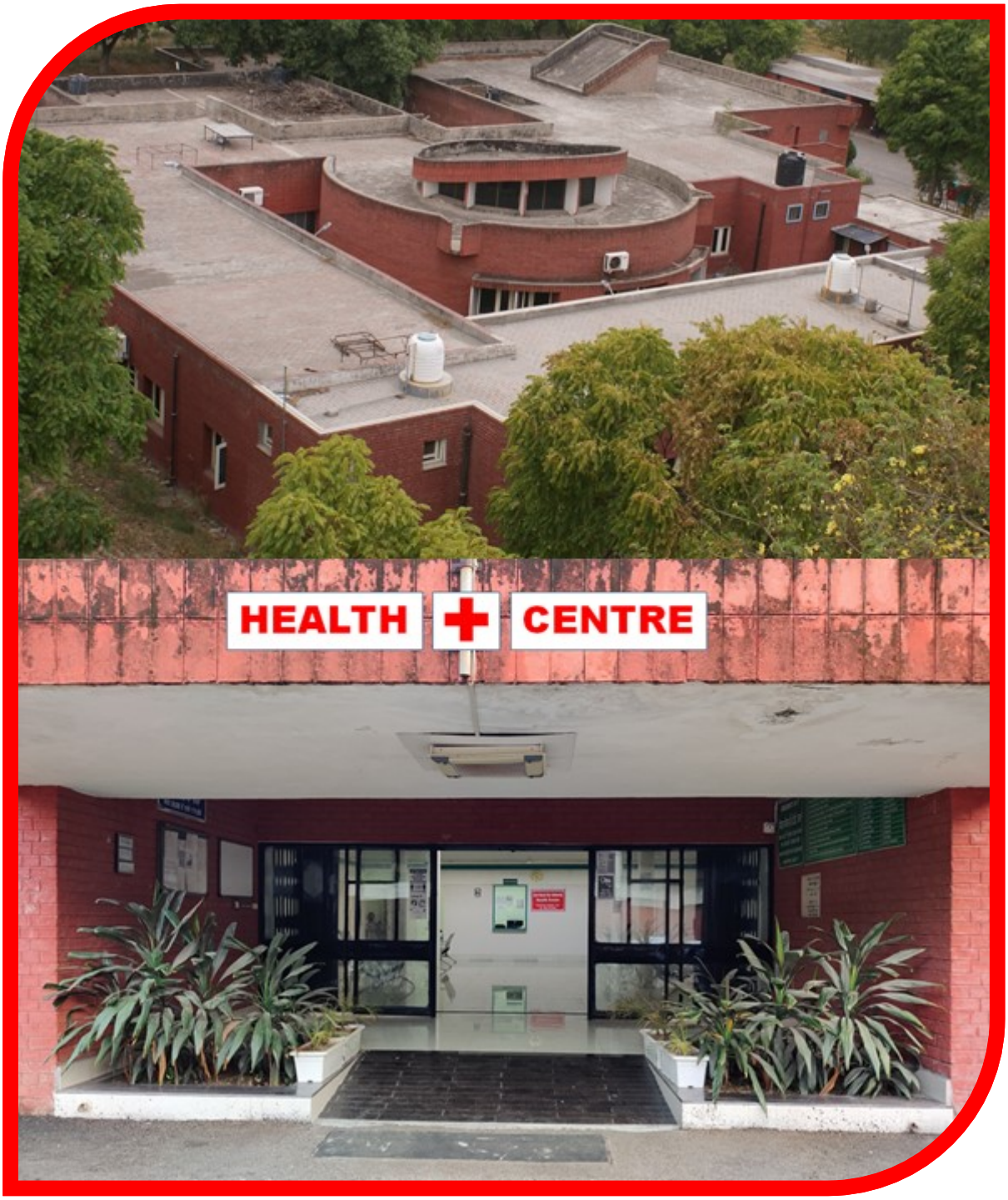


Health Centre
Guru Nanak Dev University, Amritsar, Punjab

Prepared by
Internal Quality Assurance Cell, Guru Nanak Dev University, Amritsar

ELECTRONIC WASTE MANAGEMENT REPORT

Guru Nanak Dev University
Amritsar
2020-2021

Preface

Electronic Waste (E-Waste) Management practices being followed at Guru Nanak Dev University Campus have been conceded for a period of five years i.e. 2018-2019 to 2020-2021. An audit of e-waste has been carried out to assess the waste generated in aggregate and by its type and efforts made for its management as per the guidelines of Punjab Pollution Control Board. The report on e-waste management in the university is prepared for Internal Quality Assurance Cell, GNDU by Mr. Chetan Marwaha, Nodal Officer, E-Waste, GNDU. The e-waste generated is analyzed for the whole campus and the procedure being followed to handover the e-waste to the authorized re-cycler/ dismantler firms is looked into to appreciate the guidelines being followed to handle the e-waste.

1. INTRODUCTION

Higher education institutions (HEIs) are committed to provide quality education to their students in line with the targets set for SDG 4 i.e. 'Quality Education' which mandates to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'. In the wake of achieving the seven targets set for the SDG 4, Government of India through its National Education Policy 2020 has directed all the HEIs to adopt advanced teaching techniques and technologies so that their graduates can compete in the globalizing world. Hence, these institutions have undergone tremendous transformations in teaching technologies and methods. The 'black board teaching' has largely been replaced by 'presentation based teaching'. They have been promoting internationalization of education and high quality research in varied disciplines by using various electronic and advanced computing devices since past two decades. It is evident that these electronic devices have their life, after which they need to be disposed off. Handling electronic waste (e-waste) has now become a major problem to create environmental and health issues not only in India but across the globe. Electronic Waste (e-waste) typically includes discarded computer monitors, motherboards, mobile phones and chargers, compact discs, headphones, television sets, A.C. and Refrigerators. According to the Global E-Waste Monitor 2017, India generates about 2 Million Tonnes (MT) of e-waste annually and ranks fifth among e-waste producing countries after USA, China, Japan and Germany. A report on e-waste presented by the United Nation (UN) in World Economic Forum on January 24, 2019 points out that the waste stream reached 48.5 MT and the figure is expected to double if nothing is done (Chaurasia et. al., 2021).

SDG 12 (Ensure Sustainable Consumption and Production Patterns) focus on waste management practices. It targets on reducing pollution and health impacts through environmentally sound management (ESM) of all waste, including electronic waste. The Electronic Waste Management Rules, 2016 framed under Environment (Protection) Act, 1986 are mandated to be followed in the states of India. Therefore, HEIs need to showcase to the communities and society their electronic waste management by following the innovative and best practices.

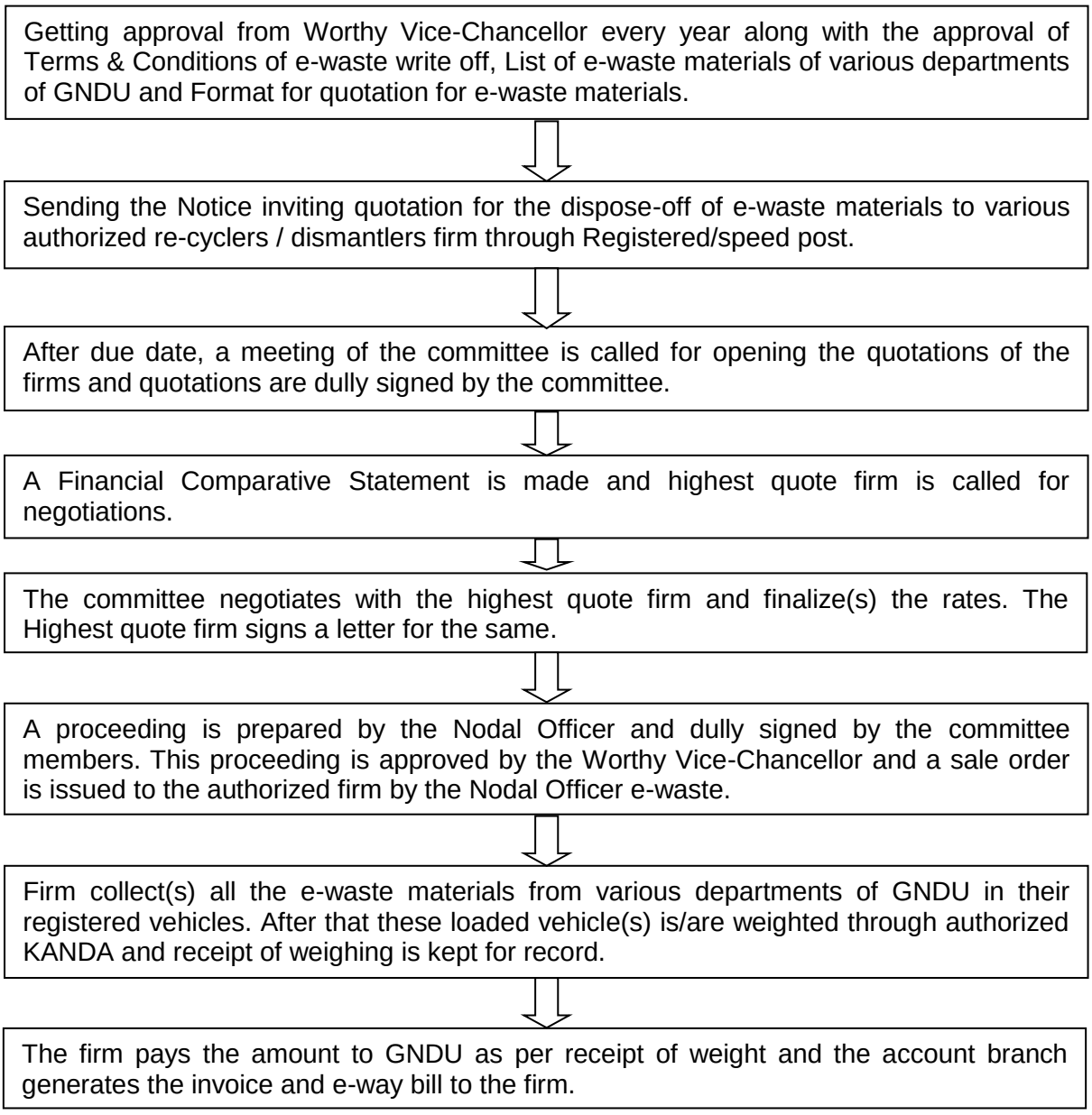
2. E-WASTE MANAGEMENT PROCEDURE AT GNDU

As per the guidelines of Central Pollution Control Board (CPCB), it is mandatory for the "Bulk Consumer" of e-waste to dispose-off its e-waste materials through authorized re-cycler/ dismantler firms registered on Central/ State Pollution Control

Board. Following the guidelines of CPCB, GNDU started its e-waste management in the academic year 2018-19. Each academic year, a committee is constituted by the Worthy Vice-Chancellor to execute e-waste handling procedure. The committee comprises of the following members.

a) Registrar.
b) Head, Department of Chemistry.
c) Incharge, Centre for I.T Solutions.
d) A.R. (General).
e) A.R. (Accounts).
f) Nodal Officer, E-Waste, G.N.D.U.

The university follows the following procedure to write off its e-waste.



3. E-WASTE GENERATION AT GNDU

The e-waste generated in GNDU and its Regional Campuses includes refrigerators, air conditioner, air cooler and water cooler, ups and batteries, electronic type writer, printer and scanner, computer (CPU)/ laptop, keyboard and mouse, electronic switches, photocopier machines, T.V, VCR and DVD player, speaker, hard disk and USB drive, projector and overhead projector, telephone and fax machine, etc. The e-waste items generated during 2018-2019, 2019-2020 and 2020-2021 by the university are listed in annexure I.

It is evident from table 1 that GNDU generated about 30.551 ton of e-waste. During 2018-2019 about 5266 kilograms of e-waste was generated, which increased to 12.20 ton in 2019-2020, registering an increment by more than double (increase of 131.66 percent). The increment was on the account that after the initiative of the university to write off the e-waste items many departments started the process. Therefore, long pending e-waste was processed in 2019-2020, resulting in high volume of e-waste. The efforts kept going on and after following the procedure about 13.09 ton e-waste was sold to the authorised re-cyclers / dismantlers firm in 2020-2021.

Table 1: E-Waste Generation in GNDU (2018-2021)

Academic Session	Quantity of E-Waste (in Ton)	Percentage Change
2018-2019	5.27	
2019-2020	12.20	**131.66**
2020-2021	13.09	**7.25**
Total Weight	**30.5512**	

4. WAY FORWARDS

It is recommended that with the objective to ease this procedure, it is suggested that GNDU may make a regular contract with an authorized firm to collect the e-waste materials from GNDU for a period agreed upon by both the parties.

Annexure – I

List of items/materials for write off through e-Waste Management (Session 2018-19)

Sr. No.	Name of Items	No. of Items
1.	PBT Telephone Set (Model-BPL 2790)	250
2.	PBT Telephone Set (Model-BPL 2790)	19
3.	PBT Telephone Set (Model-BPL 3600)	18
4.	PBT Set (Orpat)	02
5.	PBT Set (Beetal)	01
6.	PBT Set (TATA Spectra)	01
7.	PBT Set (Beetal Sigma)	01
8.	PBT Set (Beetal-802)	02
9.	PBT Set (BPL-5499l)	09
10.	PBT Set (Beetal-H22)	06
11.	PBT Set	01
12.	PBT Set	01
13.	PBT Set	01
14.	PBT Set	01
15.	PBT Set (Beetal Blue)	01
16.	PBT Set	01
17.	Model-BPL 2770	60
18.	Model-BPL 2770	02
19.	Model-Beetal	01
20.	Model-Beetal	17
21.	Model-Beetal	01
22.	Model-Siemens	01
23.	Model-Sony Eriksson	01
24.	Model-Motorola	01
25.	Model-Vectra (Two tons)	01
26.	Model-Voltas (1.5 tons)	01
27.	Sanyo	01
28.	Panasonic	01
29.	Panasonic	02
30.	Panasonic	01
31.	Sanyo-6700	01
32.	Sony	03
33.	Panasonic	01
34.	Panasonic(10CH)	02
35.	Panasonic	01
36.	Panasonic	01
37.	Sony	02
38.	Sayno (CLI-310)	01
39.	Sony (Double Line SPPM 502)	01
40.	Sony (SPPQ 110)	01
41.	Sony (Double Line)	01
42.	Sony (SP-206)	01
43.	Sony (Two Line SPPM 502)	01
44.	Sony (SPP 844 Single Line)	01
45.	Sony (Two Line SPPM 502)	01
46.	Sony (SP-151)	01
47.	Panasonic (1035 PXB Two lines)	02
48.	Panasonic Model-1035	01
49.	Panasonic Model-1085	01
50.	Panasonic Model-1035	01
51.	Panasonic Model-1035	01
52.	Panasonic Model-1085	01
53.	Panasonic Model-1035	01
54.	Beetal	01
55.	Beetal	01
56.	Beetal-53000	01
57.	Panasonic (1085)	01
58.	Beetal-53000	01
59.	Panasonic (1085BXB)	01
60.	Panasonic (Two Lines)	01
61.	Panasonic-two llnes (Model-2480)	01
62.	Panasonic-two llnes (Model-2480)	01
63.	Panasonic-two llnes (Model-1083)	01
64.	Beetal-53000	01
65.	Panasonic	01
66.	Panasonic (Two Lines)	01
67.	Panasonic (Two Lines)	01
68.	Panasonic	01
69.	Panasonic (Two Lines)	01
70.	Panasonic (Two Lines)	01
71.	Panasonic (2480- Two Lines)	01
72.	ID Caller	02
73.	ID Caller	02
74.	ID Caller	01
75.	ID Caller	01
76.	ID Caller	01
77.	Pager	01
78.	Pager	01
79.	Computer Bravo 59090 MS P/100 (AST middle east dubai)	1
80.	Computer Advantage + A-6066 (AST middle east dubai)	5
81.	HP Pentium P-166 Computers {Indocon Micro Engineer LTD (HP)}	2
82.	Pentium Computer { Indocon Micro Engineer LTD (HP)}	1
83.	Computer System SVGA nano Monitor(Indocon Micro Engineers LTD)	12
84.	Pentium System with 32 MB 102 FDD {Indocon Micro Engineer LTD (HP)}	1
85.	P-III 500 MHZ/128 MB SDRAM Server (HCL Infosystem)	1
86.	PIII 500 MHZ (HCL Infosystem)	5
87.	UPS/Volt Meter a) safe power- 4 b) datex- 4 c) HCM- 3 d) micro line-13 e) Elnova-5 f) data vision-1 g) Chirag Volt meter-1 h) Datex Volt meter-1	32
88.	INKJET COLOUR(HP) 660c	1
89.	Dot Matrix Wipro LQ 1050 DX	3
90.	HP Laser 4000N	1
91.	HP Laser 1100A	1
92.	HP Laser 4050	1
93.	HP Laser 4050	1
94.	HP Laser 5000	1
95.	Dot Matrix Wipro LQ 1050 DX	1
96.	HP Laser 8150	1
97.	Xerox M118 Printer	1
98.	HP Laser Printer 6 invono	2
99.	Remington 622878	1
100.	Facit-756179	1
101.	Remington 1682361	1
102.	Remington H-396769	1
103.	Godrej / Remington I-133385	1
104.	Remington H-351403	1
105.	Remington R-622591	1
106.	Remington R-626338	1
107.	Remington I-J407095	1
108.	Remington I-267542	1
109.	Remington I-140215	1
110.	Remington R-622822	1
111.	Remington I-167740	1
112.	Remington I-214318	1
113.	Remington 622373	1
114.	Remington R-627207	1
115.	CPU	13
116.	Monitor	6

117.	Water Cooler	1
118.	Xerox 5308	1
119.	WIPRO 10845M	34
120.	HCL Computer	10
121.	HCL Computer	28
122.	CPU	20
123.	Projector Multimedia	8
124.	HP Laserjet 1015	5
125.	Printer Sharer Auto	1
126.	HP CD Writer Plus	1
127.	Portable overhead Projector Twin Halogen Bulb	3
128.	Portable overhead Projector Twin Halogen Bulb	3
129.	Multimedia Projector	1
130.	UPS (Datex)	20
131.	UPS (Perfect)	72
132.	UPS	20
133.	UPS	6
134.	Vacuum Cleaner	1
135.	Episcope with 1200W Halogen Bulb	1
136.	Computer	01
137.	Computer Desktop	02
138.	Computer Desktop	02
139.	Printer LQ 5235	02
140.	Printer HP1160	01
141.	Printer HP-3550	01
142.	Printer HPLJ2015	02
143.	Printer TVS245	02
144.	UPS-650A	01
145.	UPS 1000VA	01
146.	UPS 500VA	02
147.	UPS 800VA	05
148.	UPS Offline 1KVA	12
149.	UPS Offline 1KVA	04

List of items/materials for write off through e-Waste Management (Session 2019-20)

Sr. No.	Item Description*	No. of Items
1.	Computer Systems	20
2.	Multimedia Kit	01
3.	Hard Disk	03
4.	Voltage Stabilizer	1+1(2)
5.	Projector Screen 180X230cm	01
6.	Fax Machine	01
7.	Air Conditioner (Window Type 1.5 Ton)	4
8.	UPS (0.8 VA)	1
9.	UPS Power 1 KVA-ETN	1
10.	A.C. Machine	20
11.	Fridge	1
12.	HCL Micro 2200	1
13.	Key Board	1
14.	Laptop	1
15.	Photostat Machine	2
16.	Printer	2
17.	Refrigerator	2
18.	Laser Printer	1
19.	Printer	2
20.	Computer	36
21.	Computer ACST	17
22.	UPS	2
23.	Circulator Refrigerator	1
24.	Computer 100 MHz	1
25.	Printer	1
26.	UPS 1KVA	2
27.	CVT 1 KVA	1
28.	UPS 1000 KVA	1
29.	UPS 5KVA	1
30.	Printer	1
31.	UPS system	1
32.	Printer	4
33.	Stabilizer	1
34.	UPS System	5
35.	Batteries	88
36.	Voltage stabilizer	1
37.	Circulator Refrigerator	1
38.	Computers	45
39.	Printer	05
40.	UPS	12
41.	CVT	10
42.	Laptop	02
43.	Projector	09
44.	Monitor	6
45.	Printer	3
46.	C.P.U.	6
47.	Microwave Diathermy with 3 radiators	1
48.	Complete Electrotherapy Unit	1
49.	Massage Unit	1
50.	Neuro Perfect NCV System	1
51.	1.5 Ton Blue Star Windows Air Conditioner	1
52.	Over Head Projector RO-200-03	1
53.	Computer HCL	1
54.	HP Deskjet Printer 695 CCI	1
55.	CVT Make “ELENT” 500 VA	1
56.	UPS (650 VA)	1
57.	HP (Laserjet) LJ 1000M Printer	1
58.	56.6 K External Modem	1
59.	0.6 KVA UPS	1
60.	Computer (HCL)	2
61.	HP All in One 3380 Printer	1
62.	Laptop	1
63.	Fax Machine, Model FC-123	1
64.	Multimedia Projector – EP 739	1
65.	Scanner – HP 2200 C	1
66.	Cyclostyle Machine	01
67.	Computer	02
68.	UPS 600 VA	02
69.	HP All in one (Scan/Print/Copy/Fax)	02
70.	Electronic Type Writer	1
71.	UPS for Computer	4
72.	Printer HP Inkjet 640C	1
73.	Printer HP Laser 1320	1
74.	Printer HP Laser	1
75.	Scanner 2200 C	1
76.	Automatic Voltage Stabilizer 5KVA Capacity Dynamic	1
77.	Monitor HCL & Speaker	1
78.	Speaker	2
79.	Speaker	1
80.	Monitor Samsung	1
81.	Printer Dot Matrix	1
82.	Printer HP Deskjet	1
83.	Samsung TV	1
84.	Refrigerator	1
85.	Portable Genset Model EBK 1200 A	1
86.	Tape Recorder	1
87.	Gestetner Duplicating Machine Model 320 A/L	1
88.	Room Heater Chetak	2
89.	Room Heater Maharaja Whiteline	1
90.	Room Heater Orpat	1
91.	Set Top Box & Dish	1

92.	DVD Player	1
93.	Pentium P– I	2
94.	Server Infinite P-II	1
95.	Nodes:- Infinite 2000 BL	5
96.	Infinite - 2000 BL, P-II	1
97.	Infinite –2000	6
98.	HCL Net Manager server P4 Xeon	1
99.	HCL Busy Bee PIV 2.4 GHz	5
100.	Computer (CPU only)	6
101.	HCL Ezee bee P-III	3
102.	UPS 1 KVA	3
103.	HP LaserJet Printer 1160	2
104.	Hp LaserJet Color Printer 3500	1
105.	UPS Model – T650A with SMF Batteries	8
106.	HP Laser Printer LJ 1150	3
107.	Transformer 2 KVA	1
108.	UPS APC 1100 VA Serial No. JBo829016047, 8Bo829016275, 8BO8244R300815	3
109.	HP LasreJet Printer 1008	2
110.	Dot Matrix Printer Epson LQ1150	1
111.	EPSON LQ 1150 II Serial No JNVY048742,EPSON FX 2175, Serial No. JSKY0001848, HDD External 500 GB	3
112.	HP LaserJet Printer 3005	1
113.	Dot Matrix Printer EPSON LQ1150 II	4
114.	APC Backups 1000 VA, Sr No.JB1017018723, JB1017018717	2
115.	650 VA offline 390 watts, Input 230 V output, 230 V UPS	2
116.	Portable DVD Writer	1
117.	HDD 500Gb External	1
118.	HP LaserJet Printer 1020	1
119.	UPS 1 KVA online	1
120.	HP LaserJet Printer 1020	3
121.	Xerox 3121 Printer	1
122.	HP Laserjet 1000 Printer	1
123.	UPS Perfect 800VA	1
124.	UPS Datex Accure 500VA	1
125.	FAX	1
126.	UPS	1
127.	Floor Fan	1
128.	Scanner HP 3670C	1
129.	Computer	04
130.	UPS (UPS 800 VA)	01
131.	UPS (UPS 1 KVA)	03
132.	Printer (HPLJ1000M)	01
133.	Television (Samsung 29' CTV)	01
134.	Printer	04
135.	Computer	03
136.	UPS	03
137.	Logic Laboratory ETB 810	1
138.	Automatic Digital IC Tester	2
139.	64 bit Static Random Access Memory LTB Type-851	1
140.	1024 bit Static Random Access Memory Type-852	1
141.	Sequential Timer ETB-63	1
142.	Seven Segment Display DB-5	1
143.	Digital Demultiplexer LTB-853	1
144.	Binary Adder Subtractor DB-4	1
145.	Microwave Oven	1
146.	Krystron Tube X-Band	4
147.	Gun Power Supply X-110/111	5
148.	Klystron Power Supply 10/10	6
149.	VSWR Meter SW- 410	10
150.	Klystron 723/AB ORK 27	3
151.	1GHz- Digital Frequency Counter	1
152.	Automatic Slide Projector (35mm with Slide Light Projection)	1
153.	LCD Multimedia Projector KYAN	1
	Compact Media Centre	
154.	Over Head Projector	3
155.	Projector Screen	2
156.	LCD Multimedia Projector 3m SVGA	1
157.	Digital Capacitance Meter (Motwane)	02
158.	CRO (Dual Trace Oscilloscope) (PM 3206 15 MHz) Phillips	10
159.	CRO (Oscilloscope) (PM3262 100 MHz)	3
160.	CRO (Oscilloscope) (50 MHz)	01
161.	CRO (Oscilloscope) 20MHz	15
162.	CRO (Oscilloscopes) (15 MHz)	14
163.	CRO (Meltoron)IE-63	05
164.	Electronics Multimeter	02
165.	Electronics Multimeter	07
166.	Multimeter Philips PM2618 12Ms(4 Digit)	4
167.	Multimeter 4 Digit	02
168.	Multimeter	7
169.	Function Generator 2821 HIL+APLAB	25
170.	Function Generator 1013 Systronics	8
171.	Function Generator (ETB-69)	01
172.	Function Generator (20 MHz)	04
173.	Function Generator with Digital Read	1
174.	Power Supply (VS-300V)	02
175.	Power Supply (Dual Regulated)	10
176.	Power Supply (0-30V)	10
177.	Power Supply (0-30V) LS-30/2	12
178.	Transistor Power Supply (0-30V)	02
179.	Power Supply PS-IV	10
180.	Regulated Power Supply (0-300V) 5A	02
181.	Electronic Temp Monitor	01
182.	Cardio Scope Mini Battery Charger	01
183.	Audiometer Model AUG 64A	01
184.	Alpha Logic Probes	05
185.	Alpha Logic Clips LCU-16	05
186.	Monostable Multivibrator	01
187.	Hybrid Parameter of Transistor	01
188.	Transistor Curve Tracer	01
189.	Relative Difference between CE, CB and CC (Coo4)	01
190.	Lux meter Blue Line GIM-403	02
191.	Lux meter Blue Line GIM-430	02
192.	Millivolt Meter	01
193.	ET-Thyset (1M)	1
194.	ET-Thyset (2 M)	1
195.	Et-Thyset (3 M)	1
196.	Et-Thyset (4M)	1
197.	ET-Thyset (5M)	1
198.	ET-Thyset (7M)	1
199.	ET-Thyset (8M)	1
200.	ET-Thyset (9M)	1
201.	ET-Thyset (10M)	1
202.	ET-Thyset (11M)	1
203.	ET-Thyset (12M)	1
204.	ET-Thyset (13M)	1
205.	ET-Thyset (14M)	1
206.	ET-Thyset (15M)	1
207.	ET-Thyset (16M)	1
208.	ET-Thyset (17M)	1
209.	(LCR Bridge) (921)	02
210.	Crystal Oscillator ETB-74	01
211.	Anderson's Bridge DS02	2
212.	Wien's Bridge DS03	2
213.	Thermocouple for temperature measurement	1
214.	HP Scanner 3300 USB	01
215.	Inkjet Printer	01
216.	Printer (HP 3323)	01
217.	HP desk jet printer 690C	01
218.	Laser Printer	01
219.	Laser Printer HP-1100	1
220.	H.P. Colour Scanner	1

221.	Panasonics printer 9 pin head 80 colane	02
222.	Ups .625VA	05
223.	Ups 1 KVA	01
224.	Ups 650VA	03
225.	Ups 1kVA power pack make 150v to 270v(7) 1KVA 650VA(10)	17
226.	UPS	01
227.	UPS 1000 KVA PERFECT	01
228.	UPS 650VA	1
229.	Radio Receiver	01
230.	Radio Receiver Transistor Design	01
231.	Servo Line Voltage Regulator 10 KVA Aplab	01
232.	UJT Saw Tooth Generator Model (B04R)	2
233.	Characteristics of SCR AC Amplication (M-B105)	2
234.	Load Cell Trainer Modules	1
235.	Temprature Measurement Training Modules	1
236.	Display Measurement L.V.D.T. Training	1
237.	Pressure Measurement Training Modules	1
238.	Stain Measurement Training Modules	1
239.	Digital Inducter Alpha neengic led display	1
240.	L.C.R. Qmeter	1
241.	TMS 320 (25 Based DSP Stater Kit)	4
242.	Software Simulator S.No. 11394	1
243.	Software Compiler C-50	1
244.	Software Fiber Design Package S. No. 11393	1
245.	TMS 320 C50 based DSP Trainer Kits Model Micro 50CB	4
246.	Internal Modem Card	1
247.	Addem Card VDSP Based Model DSP-813	1
248.	Spectrum Analyzer H.M. 5014-2	1
249.	Digital Filter Design Software	1
250.	Bloom with DSP study tutor	1
251.	D.S.K for TM320 C671	4
252.	Photo Dip Cooling Machine	1
253.	U.V Exposure Unit Single	1
254.	Frequency Micro Volt Meter	01
255.	Dish Antenna with wire and receiver	01
256.	ET Thyset (1m o/p of U.J.T)	01
257.	Amplitude Modulator and Demodulator ETB-96	04
258.	Frequency Modulator and Demodulator	07
259.	Pulse Position modulator and demodulator	03
260.	Pulse Amplitude Modulator and Demodulator	04
261.	Phase Shift Keyed (PSK)	02
262.	Frequency Shift Keyed (FSK)	02
263.	Delta Modulation and Demodulation	02
264.	Balanced Double Side Modulator and Demodulator	02
265.	Time Division Multiplexing	02
266.	Black and White TV 20" Dynamic Demonstration	01
267.	Digital to Timer Counter Card	02
268.	Stepper Motor Controller Card	01
269.	Stepper Motor Driver Card	03
270.	Stepper Motor 6Kg/Km Model SM-03	02
271.	Air conditioner 1.5 ton	02
272.	BPL Vacuum cleaner	01
273.	Automatic Transformer	04
274.	Computer System Wipro Deskjet P-4	01
275.	Pentium III Computer System	1
276.	Computer System	01
277.	Computer System Busybee 2000	01
278.	Pentium	01
279.	HCL Pentium 3	01
280.	Wipro Computer System Celeron 400Mhz.	06
281.	Celeron Computer System 700 Mhz. (HCL)	16
282.	Computer System Pentium 31 Mhz. (HCL)	01
283.	Computer System P-4(HCL)	10
284.	Computer Core 2 duo	12
285.	Computer i3 (HCL)	02
286.	Computer P(IV)	01
287.	Power Sensor	01
288.	20 GHZ Power Meter	01
289.	Digital to Timer Counter Card	01
290.	Stepper Motor Controller Card	01
291.	Stepper Motor Driver Card	03
292.	Advance Micro Lab Hil Model 2963	01
293.	Microprocessor Trainer Kit	05
294.	Microprocessor Kit VMC 8506 with Power Supplies	10
295.	Microprocessor Kit VMC Z80 with Power Supplies	05
296.	Microprocessor Kit VMC 8603-8086	05
297.	Microprocessor Kit VMC 8603-8086	05
298.	EPROM Eraser	01
299.	Vinitics Micro Development System Micro Lab III	01
300.	8097 Based Microcontroller Trainer Kit	02
301.	Verification of Laws & Network Kit ETB-64	03
302.	Electronic Training Board on passive filters	03
303.	PC-XT	5
304.	OASYS 386(25 MHz)	1
305.	SERVER: ZENITH ISA(Pentium 166 MHz)	1
306.	ZENITH ISA (Pentium 100 MHz with CD ROM) (Upgraded with HCL Celeron 950)	1
307.	PC: ZENITH ISA (Pentium 100 MHz) (Upgraded with HCL Celeron 950)	2
308.	CELERON 950, M/s. HCL Infosystems, Amritsar (Three Zenith Computers were Upgraded)	1
309.	TERMINAL (VT-220)	10
310.	INTEL PENTIUM 300 MHZ, (M/s. HCL Infotech, Noida) 300 MM, 64 MB SD RAM, 1.44 FDD, 32X CD-ROM, 104 Keys Keyboard, 15" Colored Monitor, Windows 98 with License and Manual	1
311.	INTEL PENTIUM 233 MHZ, (M/s. HCL Infotech, Noida) 300 MM, 32 MB SD RAM, 14'' SVGA Colored Monitor, 2.1 GB Ultra DMst HDD, 104 Keys Keyboard, Windows 98 with License and Manual	8
312.	TVSE MSP 45 Printers	2
313.	MSP 55 Printers	1
314.	WIPRO LQ 1050+DMP	1
315.	DOT Matrix Printer(132 Col)	1
316.	WIPRO LQ 1050+	1
317.	HP DESKJET 690C	1
318.	LASER Printer (HP 6L)	1
319.	8 Ports Serial Card	2
320.	Multi-Tech Modem 19200 BPS with S/w.	1
321.	GIST CARD	1
322.	16 Ports Hub	1
323.	20 GB HDD (Fitted in HCL Computer)	2

List of Items/materials for dispose-off through e-waste management (Session 2020-21)

Sr. No.	Item Name/Description	No. of Items
1.	Refrigerator 165 Ltr Voltas complete with voltage stabilizer and chownki	1
2.	Room Temperature Controller Digital	1
3.	UPS 500 VA	1
4.	Electrophorator System Model ECM 630 with computer System Busybee, Printer HP 3325 inkjet and UPS 600 KVA	1
5.	UPS 500 VA DATEX Acquir	1
6.	Electro Eluter model 422 biorad	1
7.	UPS 650 VA Elnova	1
8.	UPS 1KVA Online	1
9.	UPS 3 KVA	1
10.	Copier machine prodigy technology 118-2 ND	1
11.	Refrigerator (Kelvinator)310 Ltr. Capacity	1
12.	Refrigerator 310 Ltr KELVINATOR	1
13.	Laptop (Toshibha)	01
14.	Digital Power supply for vertical Dual Mini Gel System	01
15.	H.P. Scanner G3010	01
16.	Printers	03
17.	Computer HCL	01
18.	CPU	01
19.	Computers	16
20.	Computer CPU	3
21.	Computer Printer	1
22.	Computer Set	2
23.	Computer Monitor	3
24.	Home Exide Batteries With Trolley	2
25.	Home UPS 1500VA Sukam	1
26.	Printer HP Laser	2
27.	Uninterrupted Power Supply Without Batteries	1
28.	UPS	4
29.	UPS 1000KVA	1
30.	UPS16KVA	1
31.	Electronic Type Writer	1
32.	V.C.R. Onida	1
33.	Automated Photostat Machine	1
34.	Photostat Machine	1
35.	2 KVA Servo Voltage Stabilizer HCL Mark	1
36.	2 KVA Servo Voltage Stabilizer	1
37.	Colour T.V. Photo Vision	1
38.	Colour T.V. Photo Vision Sony	1
39.	Colour T.V. Photo Vision Sony	1
40.	Photophone Overhead Projector M.K. III E	1
41.	Photophone Overhead Projector M.K. III E	1
42.	Refrigerator	1
43.	Speaker (Computer)	1
44.	DVD Player	1
45.	Air Conditioner (Window)	1
46.	Air Conditioner (Window)	1
47.	Air Conditioner (Window)	1
48.	Air Conditioner (Window)	1
49.	Mouse	1
50.	Hard Disk Drive	1
51.	UPS	1
52.	C.V.T. (500 VA)	1
53.	Multimedia Projectors L.C.D. DLP Projector Enfocus	1
54.	Deskjet Printer	1
55.	USB- Mouse (Laptop)	1
56.	Air Conditioner (Windows)	1
57.	Hard Disk Drive	1
58.	Fax	1
59.	Fax	1
60.	1. Photophone Over Head Projector 2. Photophone Over Head Projector	1 1
61.	UPS	1
62.	UPS	1
63.	Multimedia Screen No- RO-207-01	2
64.	Portable Overhead Projectors No- R-O-200-06	2
65.	Multimedia Projectors Model NEC/VT/590	2
66.	Ice Flaking Machine	1
67.	Refrigerator Whirlpool With Plastic Stand	1
68.	Smart Spec Spectrophotometer with Accessories	1
69.	Electrophoresis Power Supply	1
70.	pH meter	1
71.	pH meter	1
72.	SQ GEN GT/P 3000 Sequencer	1
73.	CANON BJC 2100 Inkjet Printer	1
74.	Sony Thermal Printer Model HP895 MD	1
75.	UPS 600 VA	3
76.	Computer	1
77.	Gel Documentation System Ultra Imager	1
78.	Zenith P4 With Canon Printer	1
79.	HCL Pentium IV Computer With Printer	1
80.	My cycler Personal Thermal Cycler with accessories	1
81.	Air Conditioners 1.5 Ton	3
82.	pH meter with electrode	1
83.	UPS 5KVA	1
84.	pH meter	1
85.	UPS 2 KVA	1
86.	Solid State Voltage Stabilizer	1
87.	Transformer 2KVA	1
88.	Dry Bath with Standard Heating Block	1
89.	Heater double Rod	1
90.	Glucometer	2
91.	Electrophoresis	1
92.	Sterilizer Pressure Cooker NSW 229	1
93.	Sterilizer Pressure Cooker NSW 229	1
94.	Vacuum Pump	1
95.	Vacuum Pump	1
96.	Centrifuge REMI 4C with angle head R43, R41	1
97.	Centrifuge REMI 4C with angle head R43, R41	1
98.	Single Pan Analytical Balance	1
99.	Single Pan Analytical Balance	1
100.	Finnipipette (40-200ul	1
101.	Finnipipette (5-40ul)	1
102.	Vertical Slab Gel Electrophoresis 0503	1
103.	Horizontal Electrophoresis	1
104.	Micro centrifuge Spinwin	1
105.	Anthropometric Rod	1
106.	Air Conditioner	03
107.	Computer Monitor	01
108.	Arc Info	1
109.	Arc View	1
110.	Auto Level	1
111.	AutoCAD	1
112.	Camera Agfa	1
113.	Camera Agfa	1
114.	Camera Agfa	1
115.	Camera Agfa with leather case	1
116.	Camera Agfa with leather case	1
117.	Camera Agfa with leather case	1
118.	Camera Agfa with leather case	1
119.	Camera Agfa with leather case	1
120.	Camera Digital	1
121.	Camera Digital	1

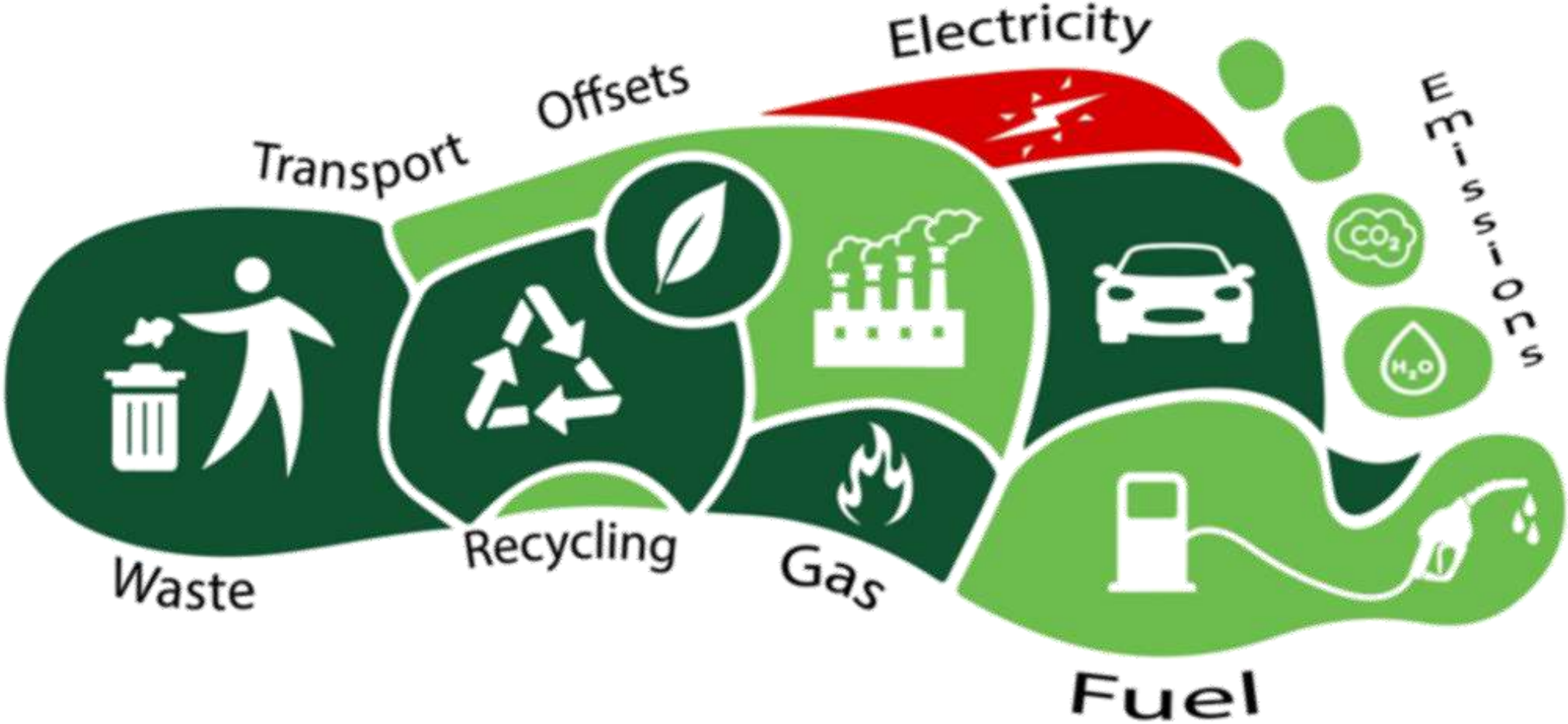
122.	Cooler	2
123.	Digital PH Meter 121-E	1
124.	E R Leather Case (for camera)	1
125.	E R Leather Case (for camera)	1
126.	E R Leather Case (for camera)	1
127.	E R Leather Case (for camera)	1
128.	E R Leather Case (for camera)	1
129.	Floppies Census Data	75
130.	Floppies Census Data	7
131.	Hard Disk External 500 GB	1
132.	LCD Projector	1
133.	LCD Projector (Epson)	1
134.	Plotter	1
135.	Printer	1
136.	Printer	1
137.	Printer	1
138.	Printer	1
139.	Software for Computer (GIS)	1 Pkt
140.	Switch/Hub	1
141.	Switch/Hub	1
142.	Switch/Hub	1
143.	Water Cooler	1
144.	Water Level Sensor	1
145.	Kodak Camera Kroma 35 mm with case	2
146.	Kodak Camera Kroma 35 mm with case	3
147.	Kodak Camera Kroma 35 mm with case	1
148.	Kodak Camera Kroma 35 mm with case	1
149.	Video Cassettes	3
150.	Video Cassettes	6
151.	Video Cassettes	5
152.	Contact Printer	1
153.	Heater 200w	1
154.	Exhaust Fan Crompton	1
155.	Typewriter	1
156.	Typewriter	1
157.	Typewriter	1
158.	Typewriter	1
159.	Bicycle ‘Atlas’ 24”	1
160.	Water Cooler (7 liters)	1
161.	Bluetooth	1
162.	Desktop Computer (Complete Set)	20
163.	Desktop Computer (Complete Set)	14
164.	Desktop Computer (Complete Set)	20
165.	External C.D. Writer	1
166.	Head Phone with Mike	1
167.	Pen Drive 1 GB	1
168.	Mouse	2
169.	Mouse	1
170.	Mouse	2
171.	Printer HP 1000 m	1
172.	Printer HP Color	1
173.	Printer HP 1160	4
174.	Printer HP TVS 9-PIN	1
175.	Scanner HP	1
176.	UPS 1 KVA	35
177.	UPS 650 VA	10
178.	UPS 600 VA	20
179.	UPS Batteries	31
180.	USB Extension Cable	2
181.	Web Cam	1
182.	Biomass Gassfire System	04
183.	Moss Baur Spectrophotometer	01
184.	NMR Spectrometer 60 MHz	01
185.	NMR Spectrometer 200 MHz	01
186.	X-Ray Diffraction	01
187.	Spectrophotometer	01
188.	ESR spectrometer	01
189.	Xeno tester	01
190.	HPLC Machine	01
191.	Thermostatic circulator	01
192.	Laser densitometer	01

193.	Telephone Set	04
194.	Manual weighing Balance	01
195.	Electronic typewriter	02
196.	Slide Projector	01
197.	Scanner	01
198.	Beta Scintillation Counter	01
199.	DNA electrophoresis Unit with power supply	01
200.	Sonicator	01
201.	CO2 incubator	02
202.	Centrifuge	04
203.	BP Monitor	01
204.	Turbojet engine model	01
205.	Diesel engine model 2 stroke	01
206.	Diesel engine model 4 stroke	01
207.	Multiplate clutch model	01
208.	Steam engine model	01
209.	Petrol engine model 4 stroke	01
210.	Double shoe break model	01
211.	Petrol engine model 2 stroke	01
212.	Wankel engine model	01
213.	Small turbine engine model	01
214.	Calculator	01
215.	Refrigerator Tutor	01
216.	Automatic coil winder	01
217.	Ultrasonic Unit	01
218.	Electronic Stethoscope	01
219.	Pulse Monitor	01
220.	Ultrasonic dopper dop	01
221.	Cardiac monitor	01
222.	Electromygraph system	01
223.	ECG machine	01
224.	TV kits with tuner knobs	04
225.	Electronic nerve stimulator	01
226.	NU2 Microscope	01
227.	DNA Thermal Cycler	01
228.	Dish Washer	01
229.	Shaking Water Bath	01
230.	Printer Canon 5200SPX	01
231.	OHP Projector	01
232.	Computer monitor with keyboard	01
233.	Clinical Autoclave	01
234.	Quartz double distillation	01
235.	Microfilteration system	01
236.	Micro pH system	01
237.	Microwave oven	01
238.	Air Purifier	01
239.	Water Bath	01
240.	UPS 10KVA	01
241.	Receptable for air purifier	01
242.	Portable data storage facility	01
243.	Mini Rotary Shaker	01
244.	Tappi T pipetting device	01
245.	BOD Incubator	02
246.	Super Micro computer	01
247.	Old Computers	06
248.	Typewriter	01
249.	Electrowave 400	01
250.	Gemsonic Ultrasound	01
251.	Glavotherm	01
252.	Ultrasound Therapy Unit	01
253.	Gestetner	02
254.	VCR	01
255.	TV SET	04
256.	Semi-Automatic Slide Projector	01
257.	Power Supplies	04
258.	UPS 600 VA	03
259.	UPS 3KVA	01
260.	Batteries 42 AH	06


E-WASTE

E-WASTE

Prepared by
Internal Quality Assurance Cell, Guru Nanak Dev University, Amritsar


Transport
Offsets
Electricity
Emissions
Waste
Recycling
Gas
Fuel