File No.EMC/91/2022-ETB-3(EED)

Energy Management Centre
(State Designated Agency to enforce Energy Conservation Act 2001)
Department of Power, Government of Kerala
Sreekrishna Nagar, Sreekariyam P.O.
Thiruvananthapuram 695 017
Tel : 0471-2594922, 2594924
E-mail: emck@keralaenergy.gov.in
Website: www.keralaenergy.gov.in

YEARS OF 150 CELEBRATING THE MAHATMA

No: EMC/91/2022-ETB-3(EED) 07/06/2022

1214
10/06/2022

SCTCE
No. 1086

The Principal
Sree Chitra Thirunal College of Engineering
Pappanamcode
Thiruvananthapuram
695018

EW / Rg: Baby
pl. speak
9/6/22

Sir,

Sub: Energy Audit Report - Reg

Ref: 1. EMC letter No. EMC/91/2022-ETB-3(EED) dated 08/04/2022

Energy Management Centre - Kerala (EMC), Department of Power, Government of Kerala is the State Designated Agency to coordinate, enforce and implement Energy Conservation Act - 2001 (Central act 52 of 2002) in Kerala. As part of the Solar City Project, we conducted an energy audit at Sree Chitra Thirunal College of Engineering.

We are enclosing herewith the final report of the energy audit conducted at "Sree Chitra Thirunal College of Engineering". We would appreciate if you could send us your action plan for the implementation of various energy efficiency and energy conservation measures. Also, request you to forward the acceptance of the report. Please note that, if the acceptance is not received within 15 days from the receipt of this letter, it may be treated as the final energy audit report is accepted.

Please feel free to contact us for any further clarifications.

Thanking you,

Yours faithfully,

Director

Encl: Energy Audit Report

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Sree Chitra Thirunal
College of Engineering
Trivandrum - 18

PAPPANAMCODE, THIRUVANANTHAPURAM

ENERGY AUDIT REPORT

SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING

THIRUVANANTHAPURAM, KERALA

FEBRUARY 2022

Energy Management Centre – Kerala

Dept of Power, Govt of Kerala.

State Designated Agency

Sreekrishna Nagar, Sreekariyam P.O.,

Thiruvananthapuram – 695 017

Ph: 0471 - 2594922, 2594924

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ENERGY AUDIT AT

SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING
THIRUVANANTHAPURAM, KERALA

Conducted By

ENERGY MANAGEMENT CENTRE – KERALA
Dept. of Power, Govt. of Kerala, State Designated Agency
Sreekrishna Nagar, Sreekariyam P.O.,
Thiruvananthapuram – 695 017
Ph: 0471 - 2594922, 2594924, Fax: 0471 – 2594923
Email: emck@keralaenergy.gov.in

Prepared by

Indira Babu Energy Ventures Pvt Ltd.
Thiruvathira, CP III 520
Kottamughal, Nalanchira P O
Thiruvananthapuram, Kerala- 695015

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CERTIFICATE

This is to certify that

The data collection has been carried out diligently and truthfully; All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorised and no tampering of such devices has occurred; All reasonable professional skill, care and diligence had been taken in preparing the energy audit report and the contents thereof are a true representation of the facts; Adequate training provided to personnel involved in daily operations after implementation of recommendations.

Jishnu Sanath
Certified Energy Auditor

SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING
PAPPANAMCODE, THIRUVANANTHAPURAM-695 018

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1. ACKNOWLEDGEMENT

We express our sincere gratitude to the management of **Sree Chitra Thirunal College of Engineering, Thiruvananthapuram** for granting us an opportunity to carry out the project of Energy Audit. We thank **Energy Management Centre Kerala** for entrusting us the work of detailed Energy Audit at **Sree Chitra Thirunal College of Engineering, Thiruvanathapuram. (SCTCE)**

SCTCE Team

- Mr. Dr. V. Syam Prakash, Principal, SCT College of Engineering
- Mr. Dr. Boby Philip, HOD Electrical Division

Our Energy Audit team

- Mr. Jishnu Sanath – Certified Energy Auditor (BEE, Govt of India)
- Dr. Vani Vijay, Technology & Research expert
- Er. Anoop Babu, Energy Consultant
- Er. Kokila Vijayakumar, Operations Head
- Er. Akhil Dev. D.J, Energy & Market Analyst
- Er. Shabinsha, Electrical Specialist
- Er. Sruthy. A.A, Engineer

Director

Energy Management Centre

Thiruvananthapuram
26-02-2022

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3. EXECUTIVE SUMMARY

The **Vydyuthi Energy Services (VES)** conducted a Detailed Energy Audit at Sree Chitra Thirunal College Thiruvananthapuram, bearing Consumer number-1345120045141 during February 2022, as per the work order issued by **Energy management Centre-Kerala.**
There is an energy saving potential of about **51739** kWh per year at an investment of Rs **2443783** summarised as below. About 21.78% energy saving potential is assessed with an annual financial savings of about Rs. **597256** and a simple payback period of **4.09 years** to recover the investment.

Sl. No	Area	Description of Work	No. of Equipment	Annual Energy Saving Potential (kWh)	Annual Financial Savings (Rs.)	Investment Required (Rs.)	Payback Period-Years
1	College Main Building	Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.	226	8846	88280	90400	1
2		Retrofitting of 2x52W (2xT12) ordinary tube light with 2x18W LED tube light.	88	9078	90598	70400	1
3		Retrofitting of 36W (T8) ordinary tube light with 18W LED tube light.	1	32	314	400	1
4		Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan	371	13126	130995	1113000	8
5		Retrofitting of existing ordinary and old air conditioner (1.5T) with inverter air conditioner/BEE star rated air conditioner.	4	2592	25868	132000	5
6		Retrofitting of existing ordinary and old air conditioner (1T) with inverter air conditioner/BEE star rated air conditioner.	6	2057	20524	180000	6
7	Main lab building	Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.	124	1314	13117	49600	4

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8		Retrofitting of 2x52W (2xT12) ordinary tube light with 2x18W LED tube light.	94	2298	22936	75200	3
9		Retrofitting of 36W (T8) ordinary tube light with 18W LED tube light.	8	72	719	3200	4
10		Retrofitting of 14W CFL bulb with 7W LED bulb.	6	135	1347	4200	3
11		Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan	102	4144	41355	306000	7
12		Retrofitting of existing ordinary and old air conditioner (1.5T) with inverter air conditioner/BEE star rated air conditioner.	1	648	6467	33000	5
13	Canteen building	Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.	37	710	7089	14800	2
14		Retrofitting of 2x52W (2xT12) ordinary tube light with 2x18W LED tube light.	44	1984	19805	35200	2
15		Retrofitting of 14W CFL bulb with 7W LED bulb.	4	15	146	480	3
16		Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan	50	1875	18713	150000	8
17	Post office building	Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.	14	357	3563	5600	2
18		Retrofitting of 36W (T8) ordinary tube light with 18W LED tube light.	3	41	404	1200	3
19		Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan	16	600	5988	48000	8
20	LAB building 2	Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.	9	102	1018	3600	4

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21		Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan	10	375	3743	30000	8
22		Retrofitting of existing ordinary and old air conditioner (2T) with inverter air conditioner/BEE star rated air conditioner.	1	686	6841	42000	6
23	CGPU Office	Retrofitting of 14W CFL bulb with 7W LED bulb.	1	4	35	120	3
24		Retrofitting of existing ordinary and old air conditioner (1.5T) with inverter air conditioner/BEE star rated air conditioner.	1	648	6467	33000	5
25	Power factor optimization from 0.87 to 1				80924	22383	4
TOTAL				**51739**	**597256**	**2443783**	**4.09**

Renewable Energy Potential

Sl. No	Description of Work	Annual Energy Generation (kWh)	Annual Equivalent Cost of Energy Generated (Rs.)	Investment Required (Rs.)	Payback Period-Years
1	Installation of 170kWp Roof Top Solar PV Power Plant as a part of renewable energy integration	244800	1517760	11050000	7.28
TOTAL		**244800**	**1517760**	**11050000**	**7.28**

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4. INTRODUCTION

ENERGY MANAGEMENT CENTRE (EMC) - KERALA

Energy Management Centre (EMC) – Kerala under Department of Power, Government of Kerala, is working towards attaining energy efficiency in all sectors of economy. EMC is formulating and implementing energy conservation projects and programs. In compliance with the Energy Conservation Act - 2001, Government of Kerala has designated EMC as the State Designated Agency (SDA) to enforce, regulate and co-ordinate the activities of Energy Conservation Act. Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India is the coordinating agency to implement the Act in the country. EMC is working very closely with Bureau of Energy Efficiency, Government of India and all the stake holders in initiating and implementing energy efficiency measures in the State.

With intention to enhance the energy efficiency of the various sectors of the economy EMC have envisaged various programs. To enhance energy conservation and energy efficiency of Low tension (LT) consumers a preliminary LT energy audit has been designed as a walk through energy audit.

Energy Management Centre (EMC) – Kerala has entrusted M/s. Indira Babu Energy Ventures Pvt. Ltd. the work of conducting energy audit at Sree Chitra Thirunal College of Engineering

Major Activities of EMC

1. Monitoring and Verification of Energy Data of Designated Consumers and their PAT Scheme.
2. Mandatory Energy Audit for HT & EHT Consumers
3. Energy Efficiency training programme at Industrial Clusters/Parks/Estates
4. Energy Conservation Building Code (ECBC)
5. Energy Efficient Street Lighting
6. Municipal Demand Side Management (MuDSM)
7. Agriculture Demand Side Management (AgDSM).
8. Go-Electric Campaign
9. Urjayan Scheme for Legislative Assembly constituencies.
10. Energy Meter Calibration & LED Testing Lab
11. Kerala State Energy Conservation Award
12. Smart Energy Program for Students
13. Energy Efficiency Capacity Building Program
14. Urjakiran - Awareness programs for general public
15. Energy Clinic
16. Research & Studies

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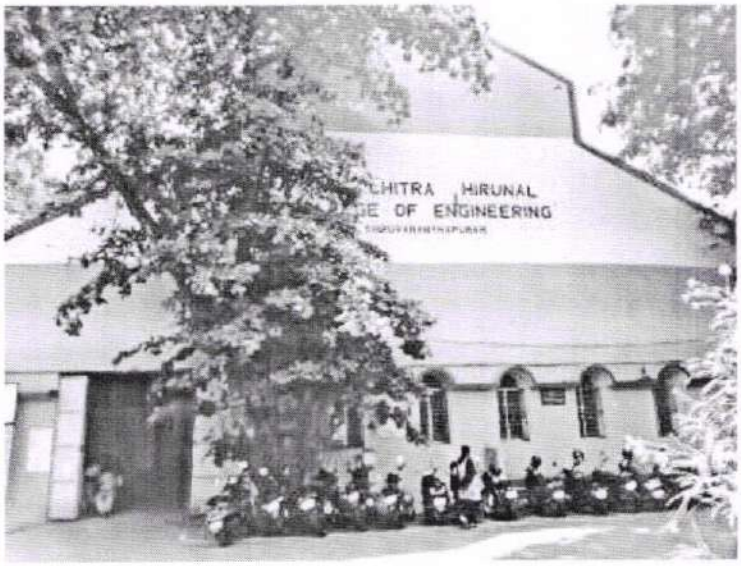
BASIC DETAILS OF THE BUILDING

Sree Chitra Thirunal College of Engineering (SCTCE), Thiruvananthapuram was established by the Govt. of Kerala in the year 1995 in memoriam of the Great Maharaja of Travancore and is affiliated to the APJ Abdul Kalam Technological University (KTU) of Kerala with AICTE approval. The Institution has the broad objective of grooming young men and women into technocrats through the process of engineering education, training and research. SCTCE offers 9 undergraduate and 3 postgraduate courses. SCTCE is also a research centre under APJ Abdul Kalam Technological University since 2015 and offers PhD programmes under the Departments of Mechanical Engineering, Electronics and Communication and Computer Science and Engineering. The accreditation of its courses by National Board of Accreditation (NBA) is a testimony to the quality of teaching learning process in the institute. The faculty members of the institute are highly experienced and most holding PhD degrees, thereby enhancing their ability to guide students to innovation and research.

The Institute also encourages students to develop their organizational, team building, presentation and other soft skills through a host of activities promoted through chapters of IEEE, ASME, CSI, SAE, EDC, NSS, KBAIC etc. SCTCE also maintains MoUs with industry and research organizations providing opportunities for students to work on real time projects. The placement statistics of the institute is one of a kind and speaks volumes about the students that graduate from the institute. A fairly large number of students also pursue higher education in premier institutes in India and abroad. SCTCE also had the privilege of being one of the top seven colleges in Kerala, aided under the World Bank funded Technical Education Quality Improvement Program (TEQIP) – phase I of the Govt of India.



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1. GENERAL INFORMATION

Basic details – Sree Chitra Thirunal College of Engineering, Thiruvananthapuram

Sl.No.	Items	Details
1	Name of the Building	Sree Chitra Thirunal College of Engineering, Thiruvananthapuram
2	Category/Type of Building (Govt Office, Hospital, LSGD etc)	Engineering College
3	Name of the Assembly Constituency with District	Thiruvananthapuram
4	Address with phone number and e-mail ID	NH 66, CTO Colony, Pappanamcode, Thiruvananthapuram, Kerala 695018, 0471-2490572, principal@sctce.ac.in
5	Name of the Contact Person with Contact details	Mr. Boby Philip 9495741482
6	Detailed energy audit last Conducted (Year)	Nil
7	Name of the audit Firm	Nil
8	Number of Government offices/Departments	4
9	Number of Staff (Permanent)	122
10	Number of students	2200
11	No of Working Hours/day	7hr/day
12	No of Working days/Year	250
13	Staff Canteen/ Restaurant	yes
14	Scope for renewable energy integration	Yes
15	Roof type (Concrete, MP Tiles etc)	Concrete/AC sheets
16	Roof - shape (Flat/ Sloping roof)	Flat, Sloping roof
17	Roof Area (Sq. M)	7828.2
18	Reflective coating on roof (Y/N)	No
19	Type of Glazing used in windows (Single Glazed / Double Glazed Window)	Single glazed
20	Whether UPS is placed inside an air conditioned room? (Y/N)	No
21	Is false ceiling provided in air conditioned area? (Y/N)	Yes
22	Automatic Lighting Controls (Y/N)	No

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Energy Details –Sree Chitra Thirunal College of Engineering, Thiruvananthapuram

Sl.no	Items	2020 - 21	2021 - 22
1	Name of the Building	Sree Chitra Thirunal College of Engineering, Thiruvananthapuram	
2	KSEBL Consumer No:	1345120045141	
3	KSEBL Section Office:	Karamana	
4	Connected Load (kW)	629.35	
5	Contract Demand (kVA)	200	
6	Recorded Average Maximum Demand (kVA)	76.9	52.33
7	Total Transformer capacity (kVA)	500	
8	Average Power Factor	0.90	0.88
9	Air conditioned area (Sq. M)	2400m2	
a.	Less than 50%	Yes	
b.	More than 50%		
10	Annual electricity consumption of the building (kWh)	1661942	1565469
11	Total built up area of the Building (Sq.m)	18985.4	
12	Specific Energy Consumption (KWh/ Sq.m)	12.65 kWh/sqm/year	
13	Water Source (Open well /KWA)	KWA	
14	Water Consumption per Year (kL)	NA	3000
15	Annual Water bill (KWA). Rs.	NA	90000
16	Number of vehicles - 4 Wheeler (Own)	NA	3
17	Number of vehicles – bus		3
18	Number of vehicles (2 Wheeler)	Nil	Nil
19	Total Diesel/ Petrol consumption of the vehicles (Litres)	NA	6350
20	Number of electric vehicles (if any)	Nil	Nil
21	Renewable Energy (Solar PV - kWp)	Nil	Nil
22	Renewable Energy (Bio gas plant - Cub. M)	Nil	Nil
23	Present status of the RE system (Working or Not) if any	Nil	
24	Own Diesel Generator (kVA)	125 kVA	
25	Annual Diesel Consumption for DG (Litres)	200litres	

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5. ENERGY & UTILITY DESCRIPTION

1. BASELINE DATA & CONSUMPTION: 12 MONTHS

The Electricity baseline data, based on the energy bills is summarized in the table below:

Table 1: BASE LINE DATA - (Based on Feb 2021- Jan 2022)

SL NO	Particulars	Data	
1	Electricity provider	KSEBL	
2	Supply voltage	11KV	
3	Tariff	HT2(B) GENERAL	
4	Consumer number	1345120045141	
5	Substation	Thirumala 33kV	
6	Contract demand (kVA)	200	
7	Maximum demand registered (kVA)	71.27	
8	Average monthly electricity consumption (kWh)	10677.25	
9	Average demand charges (Rs/month)	23025	
10	Average power factor	0.88 Lagging	
11	Monthly Average power factor incentives (Rs)	93.32	
12	Monthly Average power factor penalties (Rs)	2526.6	
13	Average Tariff rate for energy consumption (Rs/kWh)	Normal-6.2	Average - 6.72
		Peak-9.3	
		Off peak-4.65	
14	Demand charges (Rs/kVA)	440	
15	Average Monthly electricity cost (Rs)	130455.75	
16	Average cost for electricity per unit = Annual energy bill amount/Annual units consumed (For the year 2019 considering normal operation before pandemic)	9.98	

INFERENCE

1. Reference maximum demand (RMD) during the past financial year was 71.27kVA, which is 35.6 % of the contract demand.
2. Power factor was in the range of 0.88 lagging during the last financial year which resulted in a penalty of Rs. 30319.28.

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2. DEMAND ANALYSIS

The trend of Maximum Demand versus Contract Demand (CD) is analyzed over the past financial year below:

Table 2: Maximum Demand vs Contract Demand

Particulars	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22
Recorded Maximum demand (kVA)	40.5	46.5	52.88	55.69	53.72	52.71	51.27	49.45	47.89	48.24	58.4	71.27
Contract Demand(kVA)	200	200	200	200	200	200	200	200	200	200	200	200
75% of Contract demand (kVA)	150	150	150	150	150	150	150	150	150	150	150	150

INFERENCE

1. Recorded maximum demand is less than 75% of contract demand every month.

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SUGGESTION

1. Contract demand reduction can reduce the overall energy bill amount considering the overall post pandemic load and future expansion. A proposal has been created for reducing the contract demand from 200 to 150 kVA and corresponding unutilized demand charges and prospect for financial savings has been demonstrated in the following table.

Month	Present demand	Unutilized demand charges paid	75% of present Contract demand	75%Proposed contract demand	Savings in demand charges	Reduction in unutilized demand charges
Feb-21	40.5	48180	150	112.5	16500	31680
Mar-21	46.5	45540	150	112.5	16500	29040
Apr-21	52.88	42732.8	150	112.5	16500	26232.8
May-21	55.69	41496.4	150	112.5	16500	24996.4
Jun-21	53.72	42363.2	150	112.5	16500	25863.2
Jul-21	52.71	42807.6	150	112.5	16500	26307.6
Aug-21	51.27	43441.2	150	112.5	16500	26941.2
Sep-21	49.45	44242	150	112.5	16500	27742
Oct-21	47.89	44928.4	150	112.5	16500	28428.4
Nov-21	48.24	44774.4	150	112.5	16500	28274.4
Dec-21	58.4	40304	150	112.5	16500	23804
Jan-22	71.27	34641.2	150	112.5	16500	18141.2
		515451.2			**198000**	**317451.2**

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3. POWER FACTOR ANALYSIS IN ENERGY BILL

The power factor variation over the last financial year is given below:

Table 3: Power Factor vs Maximum Demand

Particulars	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22
Power factor	0.88	0.9	0.91	0.91	0.9	0.9	0.88	0.86	0.84	0.84	0.86	0.88
Maximum demand	40.54	46.5	52.88	55.69	53.12	52.71	51.27	49.45	47.89	48.24	58.4	71.27

INFERENCE

1. The average power factor is 0.88 during the last year.
2. Power factor is found to be lagging.

SUGGESTION

1. Replacement/Repair of the deteriorated capacitors in the APFC will improve the power factor and fetch incentives.

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ENERGY BILL DATA – FEB 2021 TO JAN 2022

Table 4: Energy Bill

Month	Maximum Demand (kVA)			Energy (kWh)				Avg MD (kVA)	PF	PF Incentives/penalties	Total Bill Amount (Rs)
	Normal	Peak	Off peak	Normal	Peak	Off peak	Total				
Feb-21	57.77	14.54	14.67	8538	1185	2394	12117	40.54	0.9	-375.44	14871.51
Mar-21	64.97	15.07	14.36	8694	1125	2169	11988	46.5	0.9	-744.51	147451.5
Apr-21	74.72	15.62	13.87	10197	1245	2406	13848	52.88	0.9	429.94	161362.7
May-21	62.69	19.13	14.56	6879	1170	2250	10299	55.69	0.9	2239.8	138889.9
Jun-21	24.71	12.38	12.05	3105	1002	2013	6120	53.12	0.9	5120.6	112996.6
Jul-21	31.4	12.19	12.23	3825	942	1890	6657	52.71	0.9	4332.7	115964.7
Aug-21	49.1	13.41	12.46	6045	981	1983	9009	51.27	0.9	4186.7	131817.6
Sep-21	54.08	13.55	13.35	5595	1050	2121	8766	49.45	0.9	4616.9	130584.4
Oct-21	65.38	15.41	12.57	7059	1026	2004	10089	47.89	0.8	2818.2	137959.2
Nov-21	64.76	13.72	13.39	7728	1092	2148	10968	48.24	0.8	3062.6	144199.9
Dec-21	85.65	19.39	14.98	9807	1071	2040	12918	58.4	0.9	1605	156202.6
Jan-22	108.65	19.04	17.77	11814	1218	2316	15348	71.27	0.9	1906.9	173168.5

INFERENCE

1. Overall consumption is low as the college was not functioning during the pandemic period and lack of occupancy for a major part of the year.
2. Consumption is picking up in the last 3 months as the college has partially reopened.

SUGGESTION

1. There is huge potential for more capacity utilization and future expansion considering the overall contract demand of 200kVA and available transformer of 500kVA capacity.

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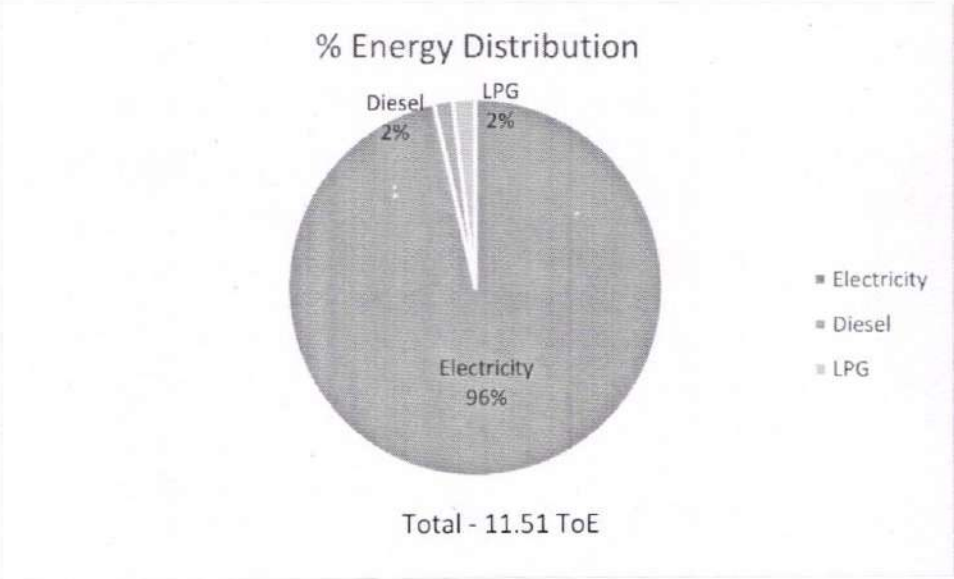
6. ENERGY PERFORMANCE

1. ANNUAL ENERGY CONSUMPTION – FEB 2021- JAN 2022

Table 5: Energy distribution

Particulars	Unit	Quantity	GCV (Kcal)	Tonne of Oil Equivalent (Toe)	% Distribution
Electricity	kWh	128127	860	11.02	95.74
Diesel	Litres	200	10800	0.22	1.57
LPG	Kg	247	10990	0.27	1.93
Total				**11.51**	



INFERENCE

- Major Energy Consumption source is Electricity which is 96 % of the total energy consumption.

2. ANNUAL ENERGY COST –FEB 2021 TO JAN 2022

Table 6: Energy distribution

Particulars	Unit	Quantity	Cost/Unit	Average Cost (Lakhs)	% Distribution
Electricity	kWh	128127	6.72	8.61	95.03
Diesel	Litres	200	92.27	0.18	1.99
LPG	Cylinder	13	2113	0.27	2.98
Total				**9.06**	

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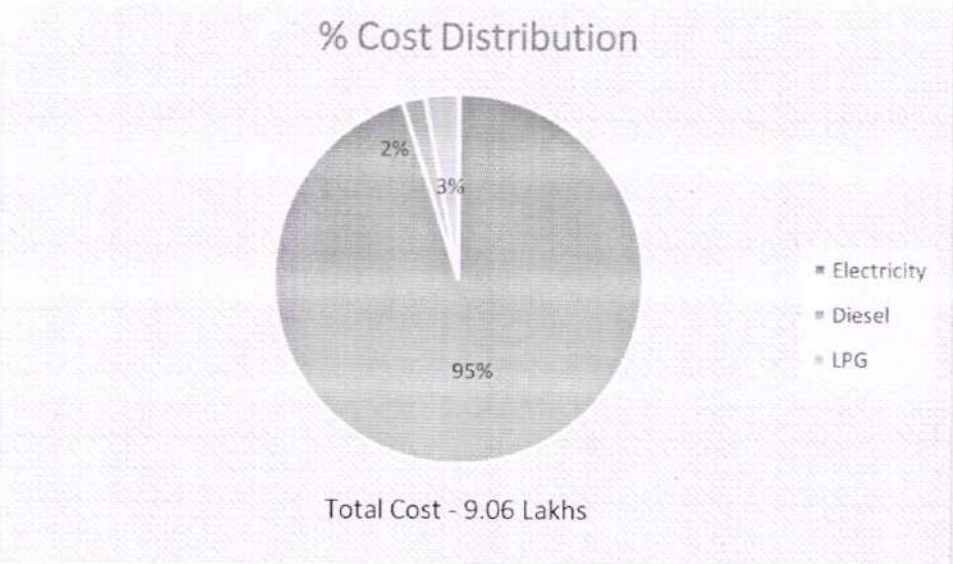

INFERENCE

1. 95% of the total energy cost is expended on electricity.

3. ENERGY PERFORMANCE INDEX

Energy Performance Index (EPI) is the key metric used for benchmarking energy usage in commercial building. EPI is the energy used per unit area measured as kWh/m2/year or kWh/person/year.

EPI is calculated for the year 2019 considering normal consumption trend before the pandemic started and after implementation of energy saving measures listed in the executive summary.

Table 7: Energy performance index

Particulars	Annual EB Energy Consumption	Annual DG Energy Consumption	Build-up Area (m2)	EPI
Unit	kWh/year	kWh/Year	m2	kWh/annum/m2
Year 2019	237558	2512	18985	**12.65**
After Implementation	185819	2512	18985	**9.92**
Reduction %	**21.78**	0	0	**21.59**

INFERENCE

1. The overall EPI Value can decrease by 21.59 % if the energy saving measures are implemented.

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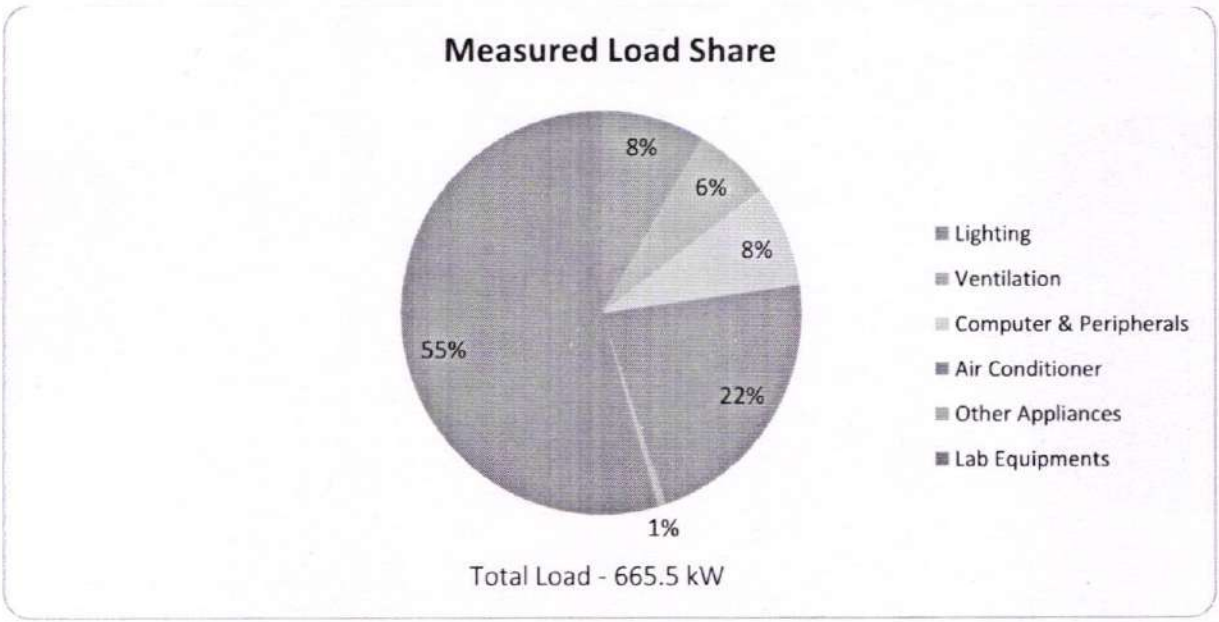
7. ENERGY PERFORMANCE ASSESSMENT OF MAJOR EQUIPMENTS

MEASURED LOAD MATRIX

Table 8: Measured Load Share

LOAD CATEGORY	LOAD (kW)	% LOAD
Lighting	55.5	8.34
Ventilation	41.6	6.24
Computer & Peripherals	54.3	8.15
Air Conditioner	146.7	22.04
Other Appliances	4	0.61
Lab Equipment	363.4	54.61
TOTAL	**665.5**	100



INFERENCE

1. Major share of the load is accounted to lab equipment while Air conditioning accounts to 22%.
2. Lighting, Ventilation and Computer accessories have nearly an equal load share.

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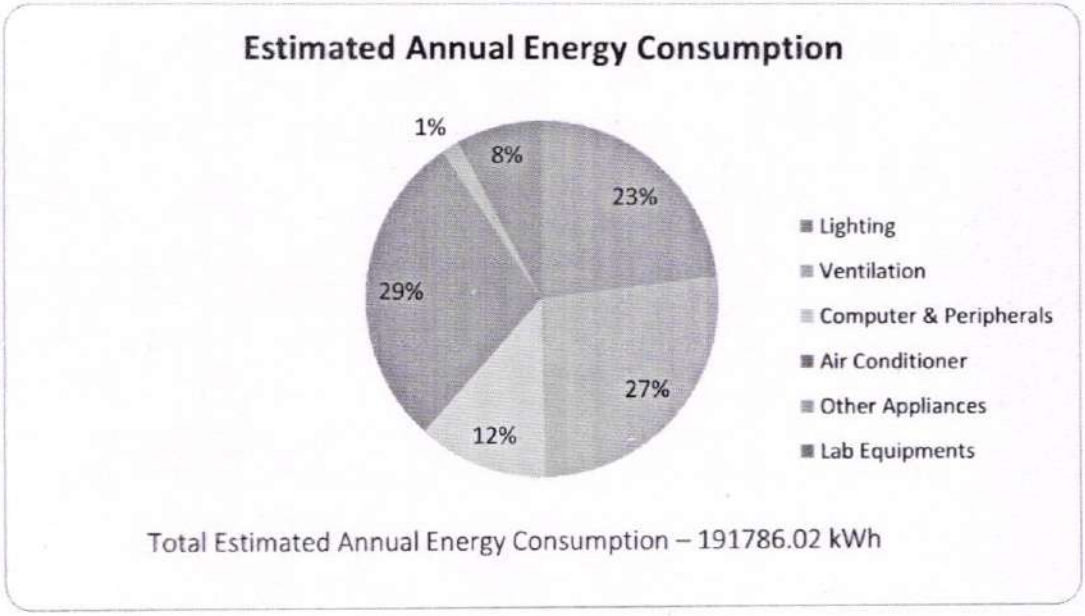
ESTIMATED ENERGY SHARE FOR DIFFERENT LOADS

Table 9: Estimated Energy Share

Estimated Annual Energy Consumption		
Particulars	**Energy (kWh)**	**Percentage**
Lighting	44108.30	23%
Ventilation* (Fan)	51252.65	26.72%
Computer & Peripherals	22918.90	11.95%
Air Conditioner	55264.74	28.82%
Other Appliances	3098.5	1.62%
Lab Equipment	15142.92	7.90%
TOTAL	191786.02	100%

*Ventilation equipment includes ceiling fans, wall fans, pedestal fan and exhaust fan



INFERENCE

1. Lighting, Ventilation and Air conditioning have nearly equal Energy usage for which energy saving recommendations are listed in the executive summary.
2. Though lab equipment accounts to major load share, Energy share is comparatively less due to less usage.

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LIST OF EQUIPMENT OR PROCESS WHERE PERFORMANCE ASSESSMENT WAS DONE

I. ELECTRICAL SYSTEM

II. DIESEL GENERATOR

III. HVAC & VENTILATION

IV. LIGHTING SYSTEM

I. ELECTRICAL SYSTEM

MAIN LOGGING OF TRANSFORMER SECONDARY SIDE

The secondary side of transformer (500kVA) was logged with power logger HIOKI PW3360 for 24 hours during the period – 09th February 2022 to 10th February 2022 (Measurement averaging period is 5 minutes) and the obtained data is summarized below:

Table 10: Transformer details

MAIN LOGGING DATA AT TRANFORMER SECONDARY				
Particulars	**Units**	**Data**		
Transformer Rating	kVA	500		
Voltage ratings	kV	11/0.433		
% Impedance	%	4.6		
Year of manufacture		2013		
MEASUREMENT VALUES				
Actual Energy for 24 hours	kWh	731.46		
Average power factor		0.86		
Particulars	Units	Minimum	Maximum	Average
Active power	kW	7.86	90.15	30.68
Apparent power	kVA	9.33	93.63	32.51
Reactive power	kVAr	-5.89	28.14	8.86
Voltage line	V	239.17	248.18	243.66
Current ratings	Amps	8.94	139	45.76

INFERENCE

1. The power factor is 0.86 lagging during the audit period.
2. The Maximum demand registered during the period is 93.63 kVA, in 5 minutes interval.
3. The maximum and average loading of the transformer were 18.72 % and 6.5% respectively in the 24 hours period.

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1. TRANSFORMER

A 500kVA transformer is installed in the facility, the load study was carried out with the following observations:

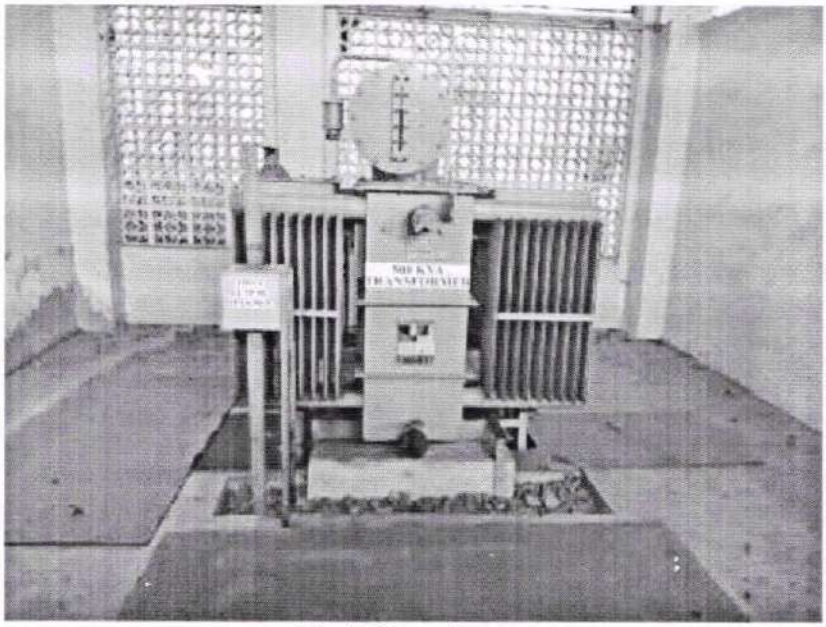

Fig 1: Transformer

Table 11: TRANSFORMER - LOSS ESTIMATION

Reference period - 3.24pm 09/02/22 to 3.24pm 10/02/22

Particulars	Unit	Quantity
HT Side Consumption (From TOD Meter)	kWh	738
Total Energy Consumption on LT Side	kWh	731.46
Total loss in transformer	%	0.89
Energy loss per day	kWh	6.54
Annual Energy loss	kWh	2387.1

INFERENCE

1. Between the TOD meter installed by KSEB and three phase power analyser installed in the LT mains, a difference of 6.54 kWh/day has been found. This is the loss in energy in between the Transformer HT side and LT substation input side. The loss is well within the allowable limits.

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2. ANALYSIS: VOLTAGE VARIATION

The Voltage profile at the transformer secondary side is plotted below:

INFERENCE

1. The figure shows minimum voltage imbalance and supply voltage variation.
2. The maximum and minimum supply voltage were 248.45 volts and 237.18 volts respectively with and average line voltage of 241.56 volts during the 24hour logging period.

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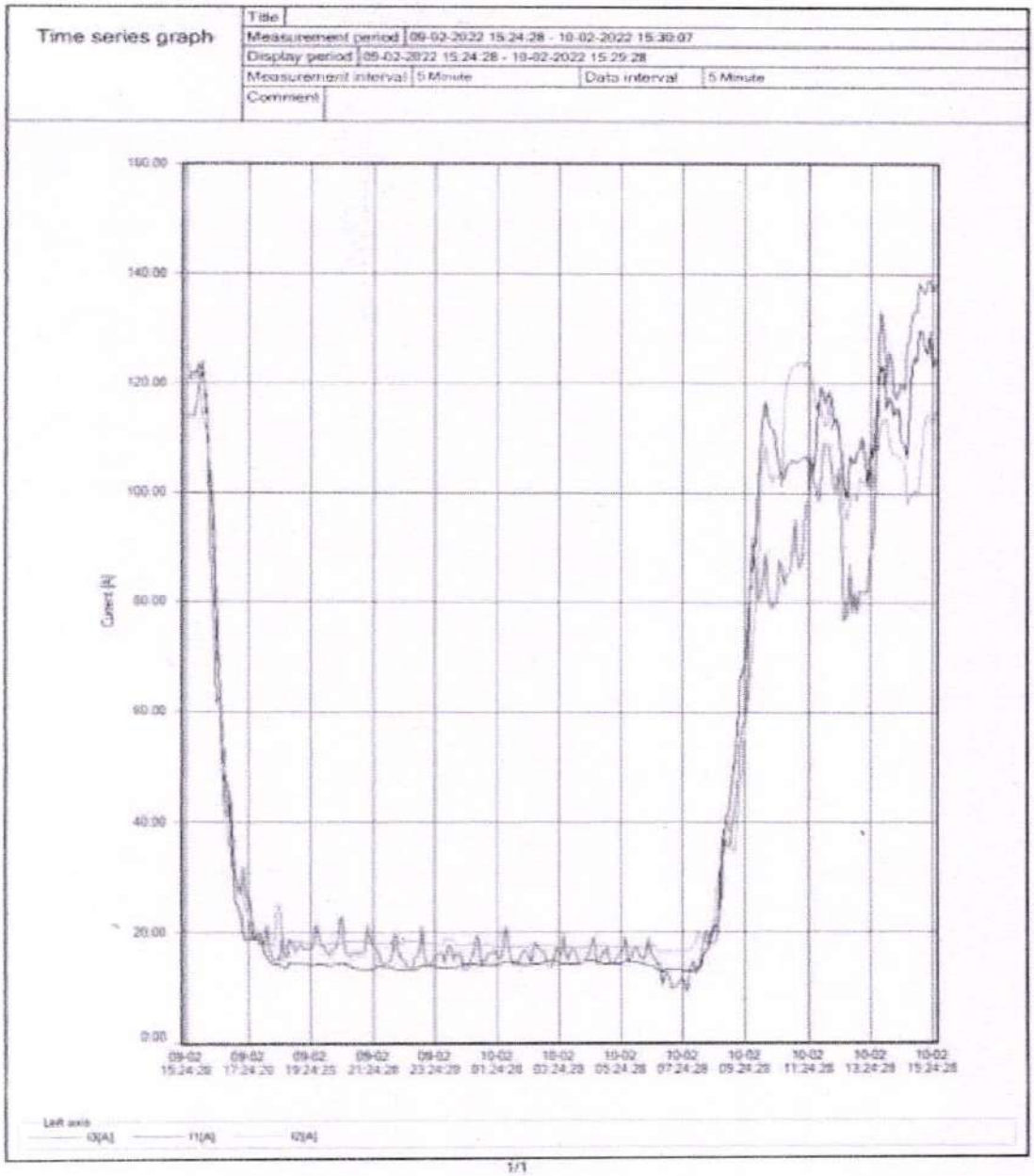
3. ANALYSIS: CURRENT VARIATIONS

The current profile at all phases at the transformer secondary side is plotted below:



INFERENCE

1. The maximum and the minimum current during the 24 hours logging period are 139 A and 8.94 A respectively.
2. The major consumption is during the day time.

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3. LOAD FACTOR

The load factor is the ratio of the energy consumed during a given period (During the audit period or last 12 months) to the energy which would have been consumed if maximum demand was maintained throughout the period.

$$\text{Load factor (\%)} = \frac{\text{Energy used during the period (kWh) x100}}{\text{Maximum demand (kW) X Time under consideration (hours)}}$$

Load factor is calculated for the 24 hours logging at the transformer secondary side in the table below:

Table 12: Load details

Zone	Total kWh	Max kW	Time (hours)	Load factor %
Normal time	606	90.15	12	**56.02**
Peak time	40	11.61	4	**86.14**
Off-Peak time	78	10.99	8	**88.72**

INFERENCE

1. Load factor is found to be low for the normal time.
2. The best load factor is in the range of 80% to 100% for a commercial establishment.

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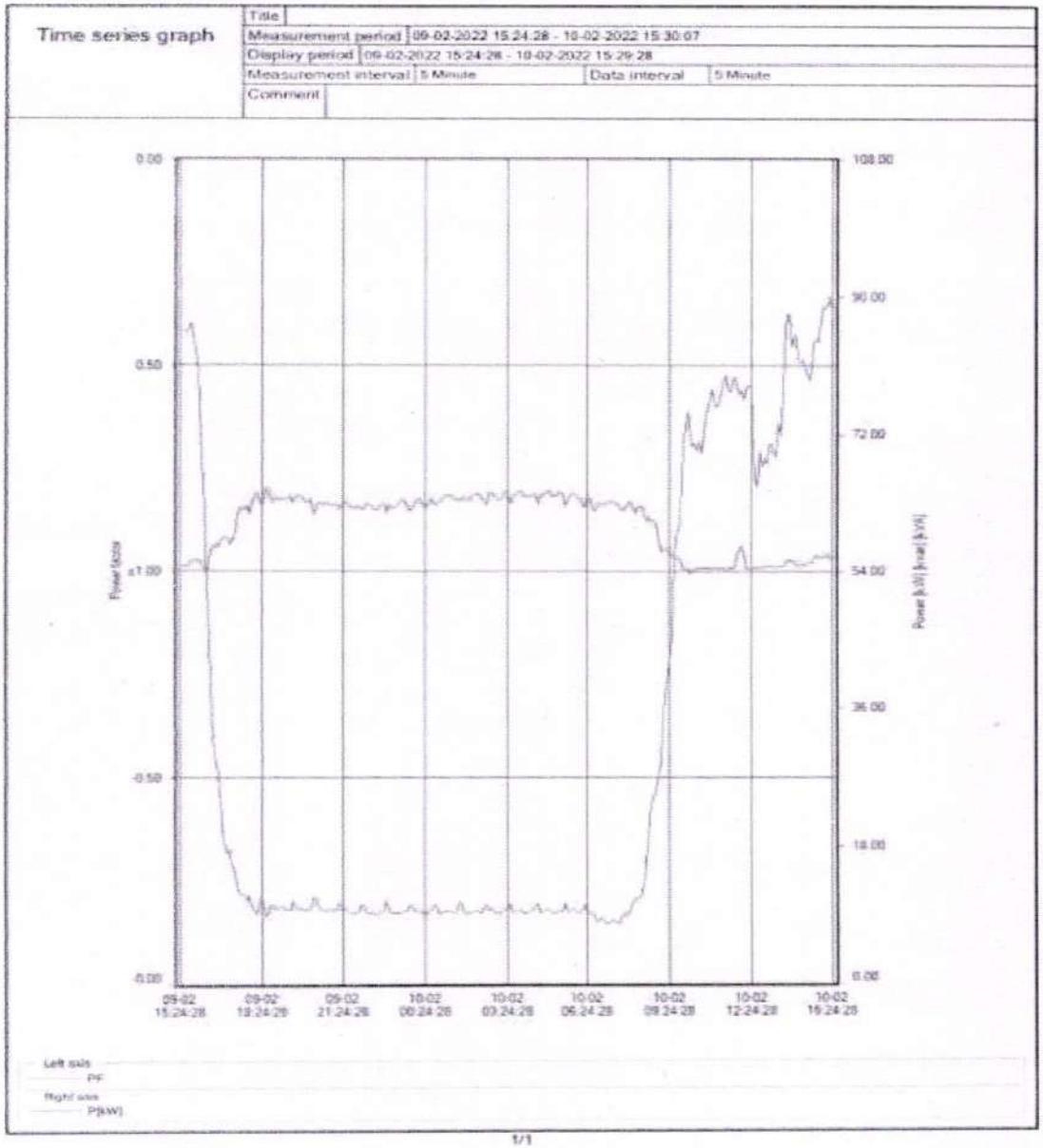
4. POWER FACTOR

The power factor variation with respect to kW Load is shown in the figure below:



INFERENCE

1. There is average power factor during the time of audit is 0.86.
2. The power factor is found to be low and hence can result in penalties.

SUGGESTIONS

1. Replace/ Repair the deteriorated capacitors from the APFC panels.

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5. AUTOMATIC PF CONTROL PANEL

The performance assessment of the APFC Panel is shown in the table below:

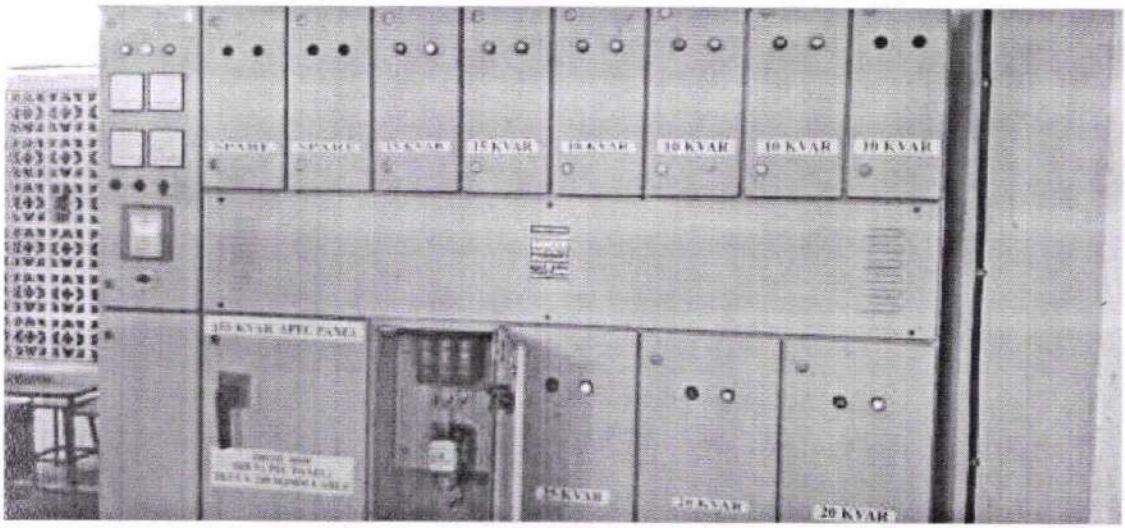

Fig 2: APFC Panel

Table 13: APFC PERFORMANCE ASSESSMENT

Name	Rated KVAr	Design Voltage	Measured Voltage	Measured KVAr	KVAr wrt Voltage	%Deterioration
	A	B	C	E	F=A*(C/B)2	G=(F-E)*(100/F)
C1	25	440	415	21	22.24	5.58
C2	25	440	415	21.76	22.24	2.16
C3	20	440	415	17.66	17.8	0.79
C4	20	440	415		Not working	
C5	15	440	415	11.23	13.35	15.89
C6	15	440	415	13.14	13.35	1.58
C7	10	440	415		Not working	
C8	10	440	415		Not working	
C9	10	440	415	7.39	8.9	16.97
C10	10	440	415		Fixed compensation	

INFERENCE

1. Power factor is found to be low due to failure of capacitors in the APFC Panel.
2. The contactors used in the panel are MNX series which are inductor duty contactors.

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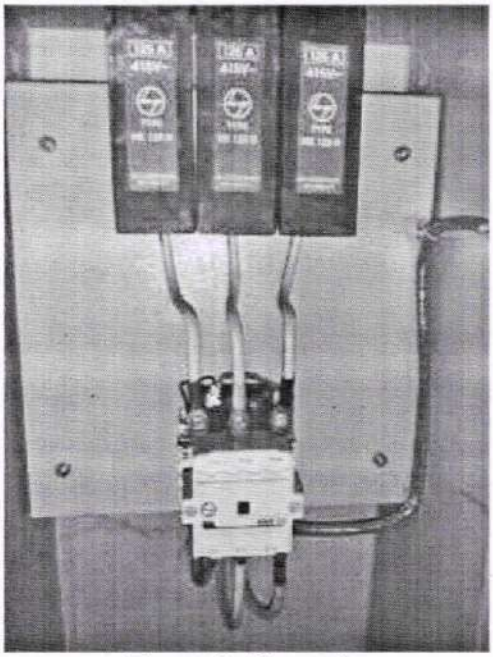

Figure 3: Capacitor

SUGGESTIONS

1. Replace/ Repair the deteriorated capacitors in the APFC Panel to improve the power factor to avoid penalties and fetch incentives in the Energy bill.
2. Change the contactors to capacitive duty contactors to avoid failures.

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II. DIESEL GENERATOR

The 125kVA diesel generator set performance analysis was done with the following observations:

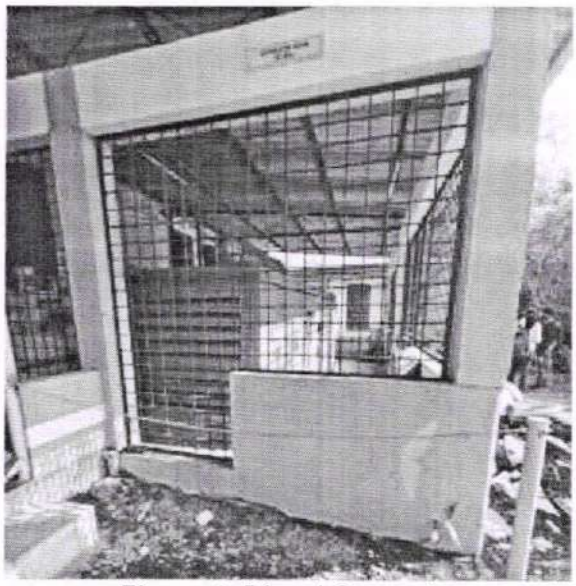

Figure 4: Diesel Generator

Table 14: DG PERFORMANCE ASSESSMENT		
Reference date - 10/02/22		
TEST DATA		
Particulars	**Unit**	**Quantity**
Average kVA Measured	kVA	40
DG Rating	kVA	125
Test run duration	Minutes	15
Energy generated during test run	kWh	18.28
Diesel consumed	Litres	7.68
INFERENCES		
Specific Energy Generation	kWh/litre	2.39
Percentage loading (Observed kVA/Rated kVA)	%	32

INFERENCE

1. The specific Energy Generation of DG is 2.39 kWh/ Litre which will improve when the loading is increased above 80%.

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III. HVAC & VENTILATION

The following table shows the split up of different HVAC Loads installed in the entire facility:

Table 15: Building wise HVAC load

SL.NO	APPLIANCE	Window AC	Non Star AC 1T	Non Star AC 1.5T	Non Star AC 2T	3 Star AC 2T	5 Star AC 2T	5 Star AC 1.5T	3 Star AC 1.5T
	Name of Building/Room/Place/Area/Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.
1	Canteen			1		14	2		
2	CGPU Building			1				1	2
3	College Building		6	4		11			7
4	Lab Building 2				1	1			2
5	Lab Building	8		1		4			2
6	Post Office Building			1					2
	Total Nos.	**8**	**6**	**8**	**1**	**30**	**2**	**1**	**15**

Table 16: Building wise Ventilation load

SL.NO	APPLIANCE	Exhaust Fan (60W)	Exhaust Fan (40W)	Pedestal Fan (55W)	Pedestal Fan 200W	Pedestal Fan 180W	Wall Fan (50W)	Wall Fan 80W	Ceiling Fan (60W)
	Name of Building/Room/Place/Area /Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.
1	Canteen	3					11		50
2	CGPU Building			1			3		
3	College Building	31	12	1			26		371
4	Lab Building 2						6		10
5	Lab Building	4		4	4	2	25	5	102
6	Post Office Building						1		16
	Total Nos.	**38**	**12**	**6**	**4**	**2**	**72**	**5**	**549**

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Table 17: Sample Performance Analysis on 2 Air Conditioners

Location		Digital Library	Skill Delivery Platform
Type		Split	Split
Installed Capacity	TR	2	2
Area	m^2	0.095	0.084
Air flow	m^3/hr	680.58	1235
Density of Air	kg/m^3	1.225	1.225
Inlet Enthalpy, H_2	Kcal/kg	15.48	15.11
Outlet Enthalpy, H_1	Kcal/kg	9.91	11.68
Enthalpy difference, $\Delta h=H_2-H_1$	Kcal/kg	5.57	3.43
Cooling Capacity	Kcal/hr	4640	5190
Effective Load	TR	1.53	1.72
Cooling in Watts	W	5386	6024
Power in Watts	W	1564	1792
EER		3.44	3.36
Rated EER		3.6	3.72
Performance Assessment		Healthy	Good

INFERENCE

1. The annual energy consumption of the inefficient NON-STAR old Air conditioning units account to 13002 kWh annually which upon replacement with efficient BEE Star labelled AC units with total annual consumption of 8428.5 kWh as per recommendations in Executive Summary can yield **Energy Savings of 4573.5 kWh annually**.

2. The annual energy consumption of inefficient ordinary fan units account to 48287 kWh annually which upon replacement with efficient BLDC Fan units with total annual consumption of 22366 kWh as per recommendations in Executive Summary can yield **Energy Savings of 25921 kWh annually**.

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IV. LIGHTING SYSTEM

The following table shows the split up of different Light Loads installed in the entire facility:

Table 18: Building wise light loads

APPLIANCE	T12 (52W)	T12X2 (104W)	T8 (36W)	CFL 70 W	CFL (14W)	LED Spot (12W)	LED Panel 40W	LED Panel – Square (15W)	LED Panel – Round (15W)	LED Tube (18W)	LED Tube 9W	LED Bulb (9W)
Name of Building/Room /Place/Area/Location	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**	**nos.**
Canteen	37	44			4				2	31		
CGPU Building		7			1				15			2
College Building	226	88	1		1		20	42	218	63	7	37
Lab Building 2	9							20		12		
Lab Building	124	94	8	6		12		12		47		2
Post Office Building	14		3							12		3
Total Nos.	**410**	**233**	**12**	**6**	**6**	**12**	**20**	**74**	**235**	**165**	**7**	**44**

INFERENCE

1. The annual energy consumption of inefficient ordinary lighting system (T12, T12X2, CFL, T8) account to 38319 kWh annually which upon replacement with efficient LED Lights with total annual energy consumption of 13373 kWh as per recommendations in Executive Summary can yield **Energy Savings of 24947 kWh annually**.

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8. POWER QUALITY ASSESSMENT

Power quality assessment involves the study of harmonics in an electrical system. **Harmonics** are described by IEEE as sinusoidal voltages or currents having frequencies that are integer multiples of the fundamental frequency at which the power system is designed to operate. This means that for a 50-Hz system, the harmonic frequencies are 100 Hz (2nd harmonic), 150 Hz (3rd harmonic) and so on. Harmonics combine with the fundamental voltage or current producing a non-sinusoidal shape, thus, a waveform distortion power quality problem. The non-sinusoidal shape corresponds to the sum of different sine waves with different magnitudes and phase angles, having frequencies that are multiples of the system frequency.

Harmonic distortion levels can be characterized by the complete harmonic spectrum with magnitudes and phase angles of each individual harmonic component. It is also common to use the Total Harmonic Distortion (THD), as a measure of the effective value of harmonic distortion. It has become an increasing concern for many end-users and for the overall power system because of the growing application of power electronics equipment. Protection from high levels of harmonics includes isolation or modification of the source, phase multiplication, pulse width modulator (PWM) and application of passive or active harmonic filters.

Causes

Harmonics exists due to the nonlinear characteristics loads and devices on the electrical power system. These devices can be modeled as current sources that inject harmonic currents into the electrical system. Consequently, voltage distortion is created as these currents produce nonlinear voltage drops across the system impedance.

Prior to the proliferation of power electronic equipment, harmonics are commonly caused by electric machines working above the knee of the magnetization curve (magnetic saturation), arc furnaces, welding machines, rectifiers, and DC brush motors. Today, all non-linear loads, such as power electronics equipment including Switched Mode Power Supplies (SMPS), Adjustable Speed Drives (ASD), high efficiency lighting and data processing equipment.

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HARMONICS DATA SHEET

Table 1.9 Maximum Harmonic Current Distortion in % of IL						
Individual Harmonic Order (Odd Harmonics)						
Isc/IL	**<11**	**11 ≤ h < 17**	**17 ≤ h < 23**	**23 ≤ h < 35**	**35 ≤ h**	**TDD**
< 20*	4.0	2.0	1.5	0.6	0.3	5.0
20 < 50	7.0	3.5	2.5	1.0	0.5	8.0
50 < 100	10.0	4.5	4.0	1.5	0.7	12.0
100 < 1000	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd current harmonic limits above.
Current distortions that result in a direct current offset, e.g. half wave converters are not allowed.
*All power generation equipment is limited to these values of current distortion, regardless of actual Isc/IL.
Where, Isc = Maximum short circuit current at PCC. I_L = Maximum Demand Load Current (fundamental frequency component) at PCC. TDD = Total demand distortion (RSS), harmonic current distortion in % of maximum demand load current (15 or 30 min demand).

Table 1.10 Total Harmonic Distribution for Different Voltage Levels in %		
Bus Voltage at PCC	**Individual Voltage Distortion (%)**	**Total Voltage Distortion THD (%)**
69 kV and below	3.0	5.0
69.001 kV Thru 161 kV	1.5	2.5
161 kV and above	1.0	1.5

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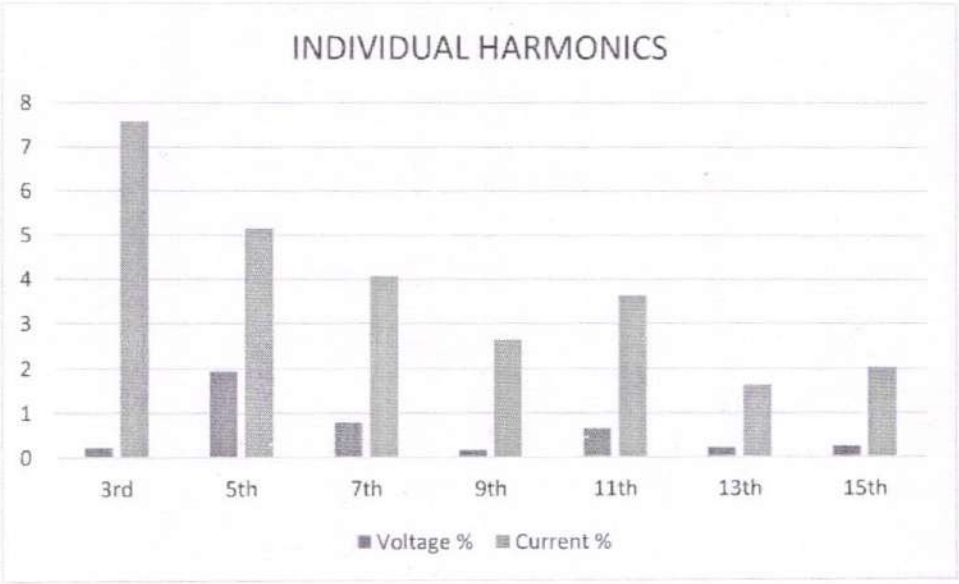
Table 19: THD Details

Location					Incoming 11 KV secondary side		
Total harmonic distortion as per CEA standard TDDi limit is 8% and THDv limit is 5% as per short circuit analysis							
Total harmonic distortion			**Voltage %**	**Current %**	**Remarks**		
			2.29	11.94	Current harmonics are found to be high		
Individual harmonics %							
Particulars	3rd	5th	7th	9th	11th	13th	15th
Voltage %	0.23	1.94	0.79	0.17	0.65	0.22	0.25
Current %	7.58	5.15	4.07	2.64	3.64	1.64	2.02



INFERENCE

1. The 3rd individual current harmonics level is 7.58 % which is higher than the permissible level of 7%.
2. The Total current harmonic distortion level is 11.94 % which is higher than the permissible level of 8%.
3. The harmonics are high due to the presence of major non-linear load share in the facility.

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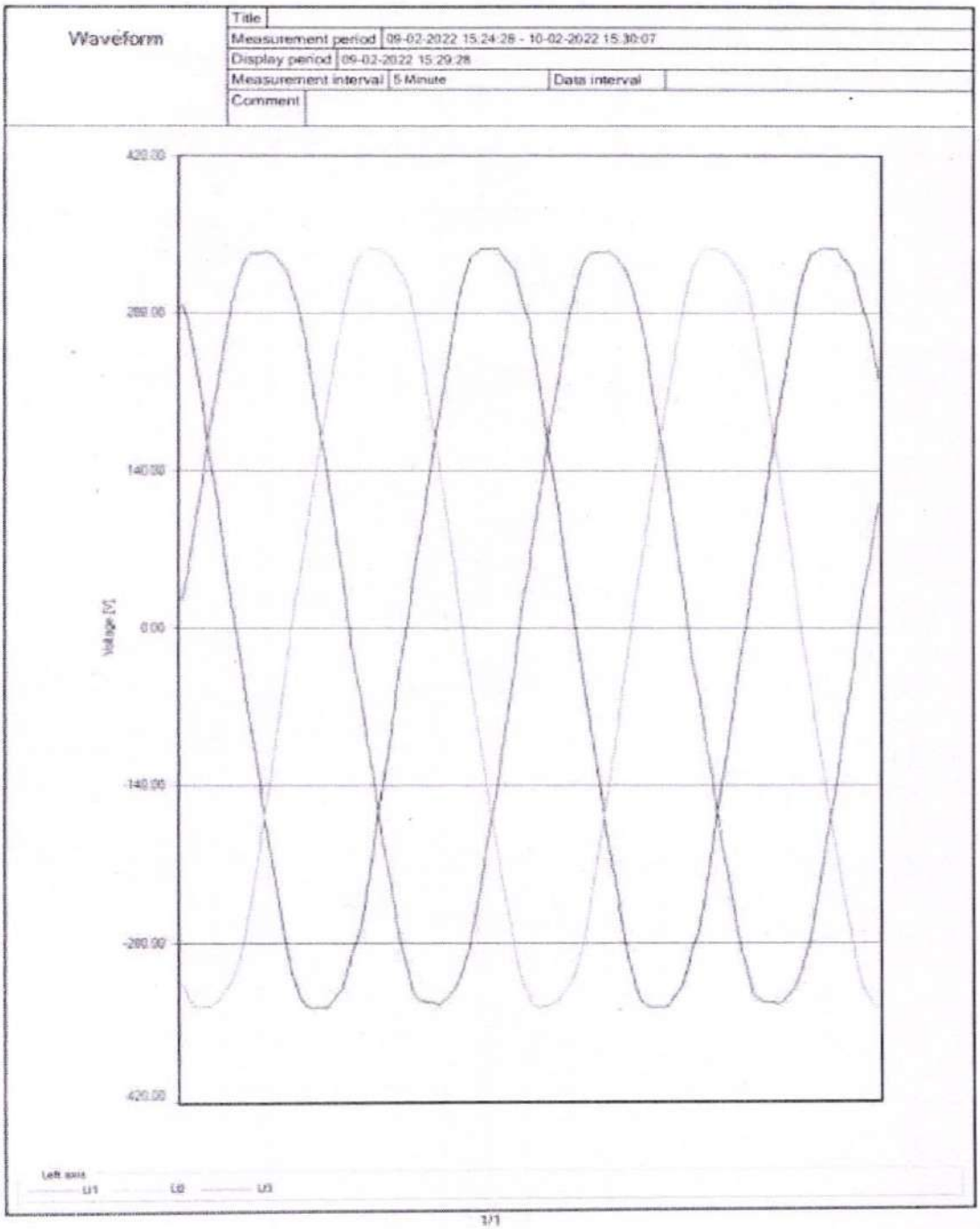
VOLTAGE WAVEFORM



INFERENCE

1. The voltage waveform obtained from the power logger data is steady and continuous.

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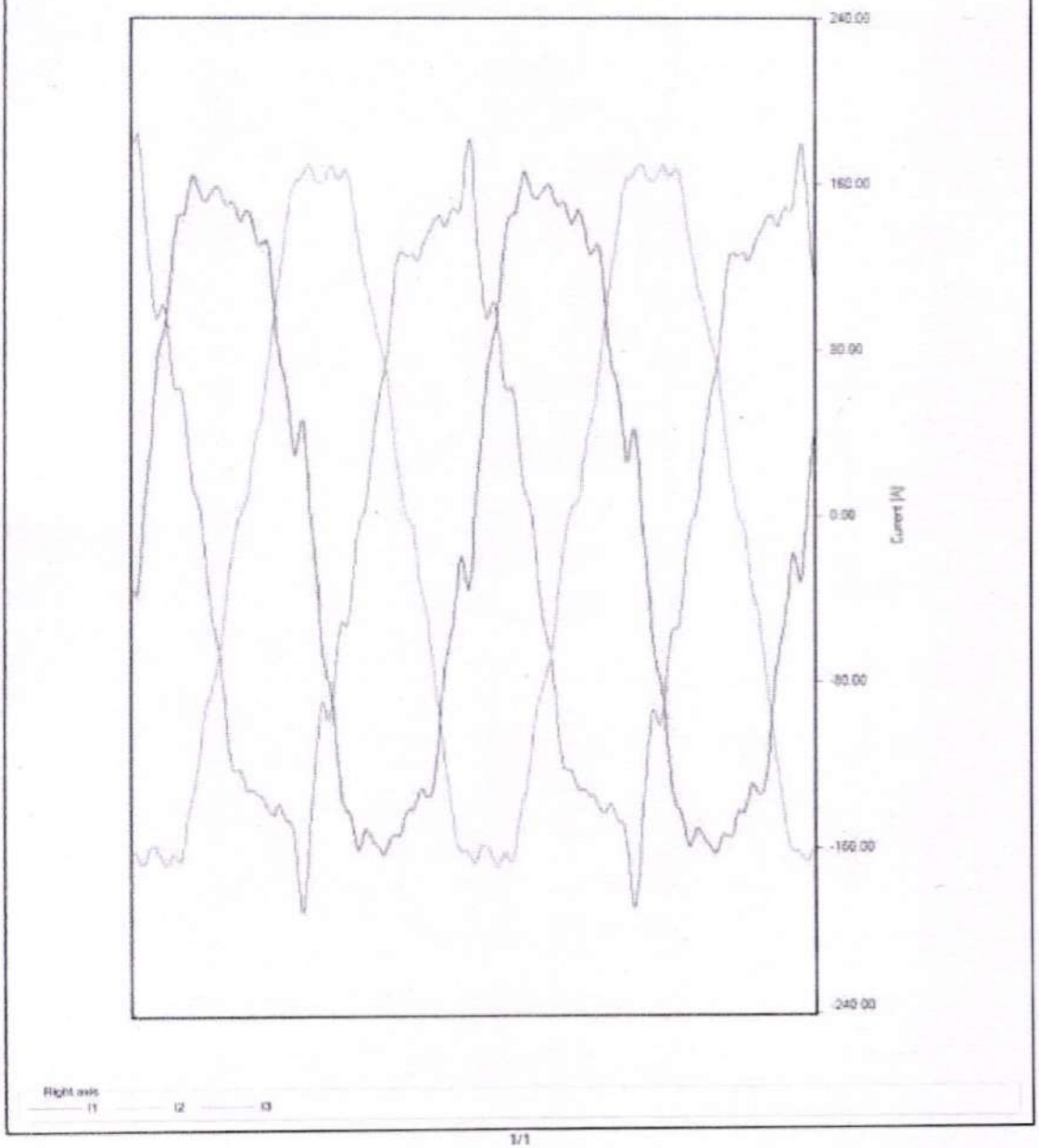
CURRENT WAVEFORM

Waveform				
	Title			
	Measurement period	09-02-2022 15:24:28 - 10-02-2022 15:30:07		
	Display period	09-02-2022 15:29:28		
	Measurement interval	5 Minute	Data interval	
	Comment			



INFERENCE

1. The current waveforms are irregular as seen in the graph due to harmonics in the system due to non-linear loads.

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POWER QUALITY DATA FROM POWER LOGGER

Table 20: Power logger data

	Reference period -	3.24pm 09/02/22 to 3.24pm		
	Reference document -	IEEE 519 Standards		
SL NO	**Particulars**	**Analysis Summary**		**Inference**
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	241.56	Normal
		Y	243.66	
		B	243.9	
3	Voltage waveforms	Slightly distorted sine waves		Normal
4	Dips & Swells	Not recorded during load study		Normal
5	Transient voltages	Not recorded during load study		Normal
6	Voltage fluctuations/flicker	Not recorded during load study		Normal
7	Power factor	0.86		Lagging pf during load study
8	Load current waveform	Highly distorted sine waves		Due to non-linear loads connected
9	Load generated disturbances	Present		Due to non-linear loads connected

Table 21: Power logger data

POWER QUALITY ANALYSIS - THD					
SL NO	**Harmonic Analysis**	**Phase**	**Load (A)**	**THD (%)**	**Inference**
Minimum load (07:34 AM -10/02/22)					
1	THD (V) % (Permissible limits<5% as per IEE 519 -2014)	R	12.96	2.07	Within permissible limit at minimum load during load study
		Y	16.72	2.07	
		B	13.17	2.19	
2	THD (I) % (Permissible limits<8% as per IEE 519 -2014	R	12.96	50.51	Above permissible limit at minimum load during load study
		Y	16.72	22.98	
		B	13.17	45.72	
Maximum load (03.19 PM - 10/02/22)					
3	THD (V) % (Permissible limits<5% as per IEE 519 -2014)	R	129.61	2.29	Within permissible limit at maximum load during load study
		Y	113.73	2.16	
		B	139	2.46	
4	THD (I) % (Permissible limits<8% as per IEE 519 -2014)	R	129.61	11.94	Above permissible limit at maximum load during load study
		Y	113.73	10.99	
		B	139	14.47	

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CURRENT IMBALANCE

Time series data		
Title		
Measurement period	09-02-2022 15:24:28 - 10-02-2022 15:30:07	
Display period	09-02-2022 15:24:28 - 10-02-2022 15:24:28	
Measurement interval	5 Minute	Data interval: 30 Minute
Comment		

Date	Time	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	U1[V]
Average value in the period		243.66	243.80	44.60	45.52	43.02	30.48	241.56
Maximum value in the period		247.98	248.29	127.25	123.89	137.63	88.60	245.67
Time of maximum value		10-02-2022 04:54:28	10-02-2022 04:54:28	10-02-2022 15:24:28	10-02-2022 11:24:28	10-02-2022 15:24:28	10-02-2022 15:24:28	10-02-2022 04:54:28
Minimum value in the period		239.53	240.47	13.00	16.54	10.81	8.22	237.67
Time of minimum value		09-02-2022 21:24:28	09-02-2022 21:24:28	10-02-2022 07:54:28	10-02-2022 07:24:28	10-02-2022 07:24:28	10-02-2022 07:24:28	09-02-2022 22:24:28
09-02-2022	15:24:28							
	15:54:28	243.59	243.27	121.92	120.49	116.68	85.65	241.53
	16:24:28	243.74	243.65	100.06	100.66	91.44	69.66	241.65
	16:54:28	243.29	243.37	47.55	42.52	46.10	31.70	241.12
	17:24:28	243.91	244.19	21.69	26.48	28.49	17.25	241.86
	17:54:28	244.39	244.44	18.51	19.21	19.56	11.94	242.51
	18:24:28	246.15	246.25	14.62	20.25	16.80	10.52	244.06
	18:54:28	244.46	244.96	14.08	18.01	17.34	9.89	242.44
	19:24:28	244.03	244.64	14.41	18.16	17.26	10.00	242.26
	19:54:28	244.77	245.65	14.25	17.87	18.35	10.16	243.28
	20:24:28	242.57	243.39	14.20	18.01	18.57	10.34	240.87
	20:54:28	241.33	242.30	13.86	18.36	16.31	9.75	239.66
	21:24:28	239.53	240.47	13.33	18.27	17.82	9.54	237.88
	21:54:28	239.73	240.78	13.79	18.08	15.18	9.51	238.01
	22:24:28	239.53	240.53	13.34	18.09	16.83	9.74	237.67
	22:54:28	239.82	241.12	13.36	18.31	14.78	9.40	238.07
	23:24:28	240.73	241.89	13.91	18.06	15.85	9.75	239.08
	23:54:28	241.85	242.80	13.54	18.27	16.31	9.77	240.13
10-02-2022	00:24:28	242.55	243.29	13.89	17.96	15.03	9.48	240.77
	00:54:28	242.66	244.31	14.12	17.87	16.27	9.79	241.79
	01:24:28	244.96	245.53	14.50	17.65	15.82	9.53	242.88
	01:54:28	245.68	246.11	14.49	17.42	16.71	9.84	243.47
	02:24:28	246.16	246.50	14.23	17.39	15.51	9.48	243.83
	02:54:28	246.75	247.07	14.28	17.62	16.98	9.82	244.36
	03:24:28	247.32	247.50	14.69	17.47	15.16	9.55	244.85
	03:54:28	247.84	248.11	14.30	17.25	16.61	9.73	245.34
	04:24:28	247.61	247.95	14.55	17.28	15.14	9.48	245.26
	04:54:28	247.98	248.29	14.59	17.53	16.37	9.83	245.67
	05:24:28	247.68	248.10	14.28	17.33	15.46	9.46	245.31
	05:54:28	246.56	247.06	14.59	17.20	16.61	9.80	244.37
	06:24:28	245.72	246.60	14.08	17.22	16.38	9.68	243.51
	06:54:28	243.35	243.69	13.21	16.73	13.23	8.79	241.40
	07:24:28	242.44	242.70	13.29	16.64	10.81	8.22	240.32
	07:54:28	242.05	242.13	13.06	17.71	12.22	8.76	239.83
	08:24:28	241.94	241.67	17.20	18.83	18.04	11.00	239.66
	08:54:28	242.46	242.64	33.33	33.98	29.47	20.51	239.85
	09:24:28	241.77	241.66	59.47	43.56	49.32	34.68	239.23
	09:54:28	240.70	240.62	91.49	78.37	81.27	58.49	238.35
	10:24:28	241.91	241.91	112.55	104.67	82.34	71.75	239.68
	10:54:28	241.93	241.82	104.45	114.23	86.43	73.07	239.98
	11:24:28	241.71	241.51	106.15	123.89	92.18	77.02	239.72
	11:54:28	241.46	241.16	111.90	117.05	103.08	78.74	239.32
	12:24:28	241.75	241.29	115.63	113.09	104.71	77.72	239.31
	12:54:28	242.45	242.24	104.37	99.56	82.48	68.51	240.17
	13:24:28	243.81	243.62	106.90	102.16	82.89	70.17	241.72
	13:54:28	245.41	244.72	116.54	108.97	115.94	81.75	243.20
	14:24:28	245.31	244.73	114.89	107.44	120.95	82.47	243.09
	14:54:28	245.39	244.68	117.18	100.50	126.88	82.23	243.15
	15:24:28	245.72	245.02	127.25	110.95	137.63	88.60	243.39

1/1

INFERENCE

The data from the 24-hour logging summary suggests that there is current imbalance between all three phases which can increase the losses and heating of contacts.

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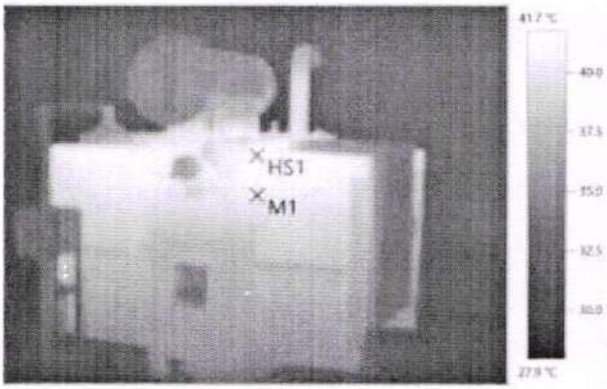
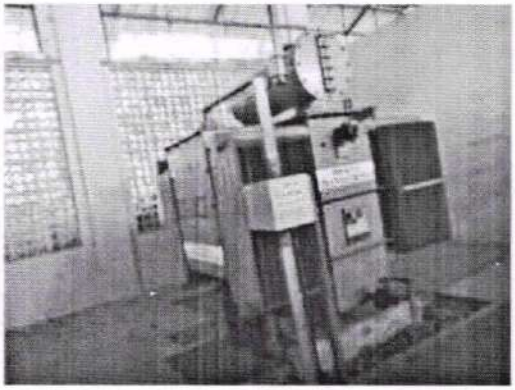
9. THERMOGRAPHY REPORT

Company	Vydyuthi Energy Services Kowdiar Trivandrum	**Customer**	Sree Chitra Thirunal College of Engineering Pappanamcode Trivandrum
Tester	Shabin Sha		

Device	testo 865	Serial	62799447	Lens:	42° x 30°
Task	Transformer - Body				





Picture	**Date:**	09-02-2022	**Emissivity:**	0.95
	Time:	16:18:34	**Refl. temp. [°C]:**	20.0
	File:	SR000030.BMT		

Picture markings:

Measurement	Temp.	Emiss.	Refl. temp.	Remarks
Measure point 1	40.5	0.95	20.0	CenterSpot
Hot spot 1	41.7	0.95	20.0	No serious hotspots were observed

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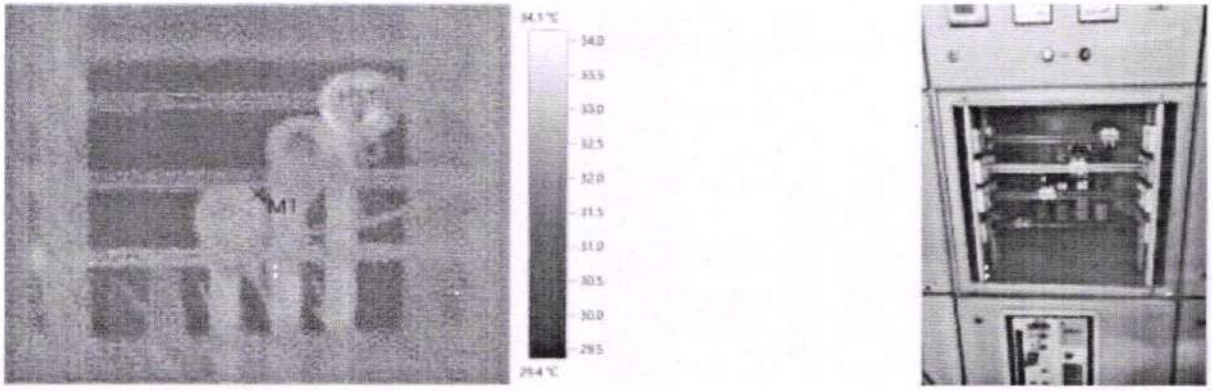
Company	Vydyuthi Energy Services Kowdiar Trivandrum	**Customer**	Sree Chitra Thirunal College of Engineering Pappanamcode Trivandrum
Tester	Shabin Sha		

Device	testo 865	Serial	62799447	Lens:	42° x 30°
Task	MSB				



Picture	**Date:**	09-02-2022	**Emissivity:**	0.95
	Time:	16:27:50	**Refl. temp. [°C]:**	20.0
	File:	SR000036.BMT		

Picture markings:

Measurement	Temp.	Emiss.	Refl. temp.	Remarks
Measure point 1	32.1	0.95	20.0	CenterSpot
Hot spot 1	34.1	0.95	20.0	No serious hotspots were observed

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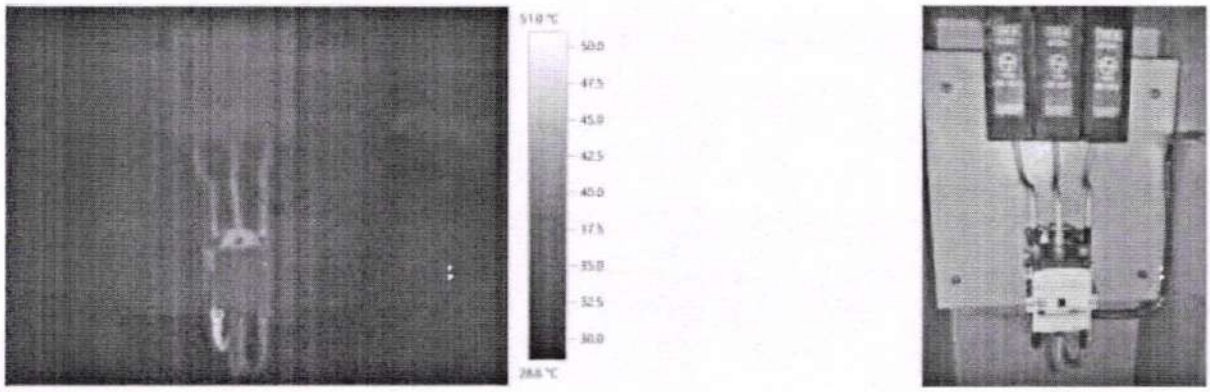
Company	Vydyuthi Energy Services Kowdiar Trivandrum	**Customer**	Sree Chitra Thirunal College of Engineering Pappanamcode Trivandrum
Tester	Shabin Sha		

Device	testo 865	Serial	62799447	Lens:	42° x 30°
Task	Capacitor Panel				



Picture	**Date:**	10-02-2022	**Emissivity:**		0.95
	Time:	12:37:42	**Refl. temp. [°C]:**		20.0
	File:	SR000037.BMT			

Picture markings:

Measurement	Temp.	Emiss.	Refl. temp.	Remarks
Measure point 1	33.8	0.95	20.0	CenterSpot
Hot spot 1	51.0	0.95	20.0	No serious hotspots were observed

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10. RECOMMENDATIONS IN DETAIL FOR ENERGY CONSERVATION

MAIN BUILDING

1. Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T12 Tube Lights	kW	0.052
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	4.60
No: of working days per year	Days	250
No: of working hours per annum	Hours	1151
No: of operating T12 Tube lights	Nos	226
Annual consumption for T12Tube Lights	KWh	13529
Annual consumption for LED Tube Lights	KWh	4683
Unit Savings per annum	KWh	8846
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**88280**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**90400**
Simple Payback period	Years	**1**

2. Retrofitting of 2x52W (2xT12) ordinary tube light with 2x18W LED tube light.

Particulars	Unit	Quantity
Existing T12x2 Tube Lights	kW	0.104
Proposed LED Tubex2 Light	kW	0.036
Avg No: of working hours/day	Hours	6.07
No: of working days per year	Days	250
No: of working hours per annum	Hours	1517
No: of operating T12x2 Tube lights	Nos	88
Annual consumption for T12x2 Tube Lights	KWh	13884
Annual consumption for LED Tubex2 Lights	KWh	4806
Unit Savings per annum	KWh	9078
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**90598.44**
Cost of LED Tubex2 Lights	Rs	800
Investment for LED Tubex2 Lights	Rs	**70400**
Simple Payback period	Years	**1**

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3. Retrofitting of 36W (T8) ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T8 Tube Lights	kW	0.036
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	7.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	1750
No: of operating T8 Tube lights	Nos	1
Annual consumption for T8 Tube Lights	KWh	63
Annual consumption for LED Tube Lights	KWh	32
Unit Savings per annum	KWh	32
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**314**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**400**
Simple Payback period	Years	**1**

4. Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan

Particulars	Unit	Quantity
Existing Ceiling fan	kW	0.06
Proposed BLDC Fan	kW	0.035
Avg No: of working hours/day	Hours	5.66
No: of working days per year	Days	250
No: of working hours per annum	Hours	1415
No: of operating Ceiling Fans	Nos	371
Annual consumption for Ceiling Fans	KWh	31501.88
Annual consumption for BLDC Fans	KWh	18376.09
Unit Savings per annum	KWh	13126
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**130995**
Cost of BLDC Fan	Rs	3000
Investment for BLDC Fans	Rs	**1113000**
Simple Payback period	Years	**8**

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5. Retrofitting of existing ordinary and old air conditioner (1.5T) with inverter air conditioner/BEE star rated air conditioner.

Particulars	Unit	Quantity
Existing Non star AC 1.5T	kW	2.364
Proposed BEE Star Rated Inverter AC	kW	1.5
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750
No: of operating Non star AC	Nos	4
Annual consumption for Non star AC	KWh	7092
Annual consumption for 5 Star AC	KWh	4500
Unit Savings per annum	KWh	2592
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**25868**
Cost of 5 Star AC	Rs	33000
Investment for 5 Star AC	Rs	**132000**
Simple Payback period	Years	**5**

6. Retrofitting of existing ordinary and old air conditioner (1T) with inverter air conditioner/BEE star rated air conditioner.

Particulars	Unit	Quantity
Existing Non star AC 1T	kW	1.576
Proposed BEE Star Rated Inverter AC	kW	1.119
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750
No: of operating Non star AC	Nos	6
Annual consumption for Non star AC	KWh	7092
Annual consumption for 5 Star AC	KWh	5036
Unit Savings per annum	KWh	2057
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**20524**
Cost of 5 Star AC	Rs	30000
Investment for 5 Star AC	Rs	**180000**
Simple Payback period	Years	**6**

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7. Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T12 Tube Lights	kW	0.052
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	1.25
No: of working days per year	Days	250
No: of working hours per annum	Hours	312
No: of operating T12 Tube lights	Nos	124
Annual consumption for T12Tube Lights	KWh	2010
Annual consumption for LED Tube Lights	KWh	696
Unit Savings per annum	KWh	1314
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**13117**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**49600**
Simple Payback period	Years	**4**

8. Retrofitting of 2x52W (2xT12) ordinary tube light with 2x18W LED tube light.

Particulars	Unit	Quantity
Existing T12x2 Tube Lights	kW	0.104
Proposed LED Tubex2 Light	kW	0.036
Avg No: of working hours/day	Hours	1.44
No: of working days per year	Days	250
No: of working hours per annum	Hours	360
No: of operating T12x2 Tube lights	Nos	94
Annual consumption for T12x2 Tube Lights	KWh	3515
Annual consumption for LED Tubex2 Lights	KWh	1217
Unit Savings per annum	KWh	2298
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**22936**
Cost of LED Tubex2 Lights	Rs	800
Investment for LED Tubex2 Lights	Rs	**75200**
Simple Payback period	Years	**3**

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9. Retrofitting of 36W (T8) ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T8 Tube Lights	kW	0.036
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	2.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	500
No: of operating T8 Tube lights	Nos	8
Annual consumption for T8 Tube Lights	KWh	144
Annual consumption for LED Tube Lights	KWh	72
Unit Savings per annum	KWh	72
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**719**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**3200**
Simple Payback period	Years	**4**

10. Retrofitting of 14W CFL bulb with 7W LED bulb.

Particulars	Unit	Quantity
Existing CFL	kW	0.07
Proposed LED Bulb	kW	0.04
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750
No: of operating CFL	Nos	6
Annual consumption for CFL	KWh	315
Annual consumption for LED Bulb	KWh	180
Unit Savings per annum	KWh	135
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**1347**
Cost of LED Bulb	Rs	700
Investment for LED Bulbs	Rs	**4200**
Simple Payback period	Years	**3**

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11. Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan

Particulars	Unit	Quantity
Existing Ceiling fan	kW	0.06
Proposed BLDC Fan	kW	0.035
Avg No: of working hours/day	Hours	6.50
No: of working days per year	Days	250
No: of working hours per annum	Hours	1625
No: of operating Ceiling Fans	Nos	102
Annual consumption for Ceiling Fans	KWh	9945
Annual consumption for BLDC Fans	KWh	5801
Unit Savings per annum	KWh	4144
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**41355**
Cost of BLDC Fan	Rs	3000
Investment for BLDC Fans	Rs	**306000**
Simple Payback period	Years	**7**

12. Retrofitting of existing ordinary and old air conditioner (1.5T) with inverter air conditioner/BEE star rated air conditioner.

Particulars	Unit	Quantity
Existing Non star AC 1.5T	kW	2.364
Proposed BEE Star Rated Inverter AC	kW	1.5
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750
No: of operating Non star AC	Nos	1
Annual consumption for Non star AC	KWh	1773
Annual consumption for 5 Star AC	KWh	1125
Unit Savings per annum	KWh	648
Cost per kWh(Average)	Rs	9.98
Annual financial savings	Rs	**6467**
Cost of 5 Star AC	Rs	33000
Investment for 5 Star AC	Rs	**33000**
Simple Payback period	Years	**5**

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CANTEEN BUILDING

13. Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T12 Tube Lights	kW	0.052
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	2.26
No: of working days per year	Days	250
No: of working hours per annum	Hours	564.68
No: of operating T12 Tube lights	Nos	37
Annual consumption for T12Tube Lights	KWh	1086
Annual consumption for LED Tube Lights	KWh	376
Unit Savings per annum	KWh	710
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**7089**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**14800**
Simple Payback period	Years	**2**

14. Retrofitting of 2x52W (2xT12) ordinary tube light with 2x18W LED tube light.

Particulars	Unit	Quantity
Existing T12x2 Tube Lights	kW	0.104
Proposed LED Tubex2 Light	kW	0.036
Avg No: of working hours/day	Hours	2.65
No: of working days per year	Days	250
No: of working hours per annum	Hours	663
No: of operating T12x2 Tube lights	Nos	44
Annual consumption for T12x2 Tube Lights	KWh	3035
Annual consumption for LED Tubex2 Lights	KWh	1051
Unit Savings per annum	KWh	1984
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**19805**
Cost of LED Tubex2 Lights	Rs	800
Investment for LED Tubex2 Lights	Rs	**35200**
Simple Payback period	Years	**2**

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15. Retrofitting of 14W CFL bulb with 7W LED bulb.

Particulars	Unit	Quantity
Existing CFL	kW	0.014
Proposed LED bulb	kW	0.007
Avg No: of working hours/day	Hours	2.08
No: of working days per year	Days	250
No: of working hours per annum	Hours	521
No: of operating CFL	Nos	4
Annual consumption for CFL	KWh	29
Annual consumption for LED bulb	KWh	15
Unit Savings per annum	KWh	15
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**146**
Cost of LED bulb	Rs	120
Investment for LED bulb	Rs	**480**
Simple Payback period	Years	**3**

16. Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan

Particulars	Unit	Quantity
Existing Ceiling fan	kW	0.06
Proposed BLDC Fan	kW	0.035
Avg No: of working hours/day	Hours	6.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	1500
No: of operating Ceiling Fans	Nos	50
Annual consumption for Ceiling Fans	KWh	4500
Annual consumption for BLDC Fans	KWh	2625
Unit Savings per annum	KWh	1875
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**18713**
Cost of BLDC Fan	Rs	3000
Investment for BLDC Fans	Rs	**150000**
Simple Payback period	Years	**8**

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POST OFFICE BUILDING

17. Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T12 Tube Lights	kW	0.052
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750.00
No: of operating T12 Tube lights	Nos	14
Annual consumption for T12Tube Lights	KWh	546
Annual consumption for LED Tube Lights	KWh	189
Unit Savings per annum	KWh	357
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**3563**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**5600**
Simple Payback period	Years	**2**

18. Retrofitting of 36W (T8) ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T8 Tube Lights	kW	0.036
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750
No: of operating T8 Tube lights	Nos	3
Annual consumption for T8 Tube Lights	KWh	81
Annual consumption for LED Tube Lights	KWh	41
Unit Savings per annum	KWh	41
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**404**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**1200**
Simple Payback period	Years	**3**

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19. Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan

Particulars	Unit	Quantity
Existing Ceiling fan	kW	0.06
Proposed BLDC Fan	kW	0.035
Avg No: of working hours/day	Hours	6.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	1500
No: of operating Ceiling Fans	Nos	16
Annual consumption for Ceiling Fans	KWh	1440
Annual consumption for BLDC Fans	KWh	840
Unit Savings per annum	KWh	600
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**5988**
Cost of BLDC Fan	Rs	3000
Investment for BLDC Fans	Rs	**48000**
Simple Payback period	Years	**8**

SECOND LAB BUILDING

20. Retrofitting of 52W (T12) Ordinary tube light with 18W LED tube light.

Particulars	Unit	Quantity
Existing T12 Tube Lights	kW	0.052
Proposed LED Tube Light	kW	0.018
Avg No: of working hours/day	Hours	1.33
No: of working days per year	Days	250
No: of working hours per annum	Hours	333
No: of operating T12 Tube lights	Nos	9
Annual consumption for T12Tube Lights	KWh	156
Annual consumption for LED Tube Lights	KWh	54
Unit Savings per annum	KWh	102
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**1018**
Cost of LED Tube Lights	Rs	400
Investment for LED Tube Lights	Rs	**3600**
Simple Payback period	Years	**4**

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21. Retrofitting of existing inefficient ceiling fan with BEE 5 star rated (BLDC) ceiling fan

Particulars	Unit	Quantity
Existing Ceiling fan	kW	0.06
Proposed BLDC Fan	kW	0.035
Avg No: of working hours/day	Hours	6.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	1500
No: of operating Ceiling Fans	Nos	10
Annual consumption for Ceiling Fans	KWh	900
Annual consumption for BLDC Fans	KWh	525
Unit Savings per annum	KWh	375.00
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**3742.50**
Cost of BLDC Fan	Rs	3000
Investment for BLDC Fans	Rs	**30000**
Simple Payback period	Years	**8**

22. Retrofitting of existing ordinary and old air conditioner (2T) with inverter air conditioner/BEE star rated air conditioner.

Particulars	Unit	Quantity
Existing Non star AC 2T	kW	3.152
Proposed BEE Star Rated Inverter AC	kW	2.238
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750
No: of operating Non star AC	Nos	1
Annual consumption for Non star AC	KWh	2364
Annual consumption for 5 Star AC	KWh	1679
Unit Savings per annum	KWh	686
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**6841**
Cost of 5 Star AC	Rs	42000
Investment for 5 Star AC	Rs	**42000**
Simple Payback period	Years	**6**

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23. Retrofitting of 14W CFL with 7W LED bulb

Particulars	Unit	Quantity
Existing CFL	kW	0.014
Proposed LED bulb	kW	0.007
Avg No: of working hours/day	Hours	2.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	500
No: of operating CFL	Nos	1
Annual consumption for CFL	KWh	7.00
Annual consumption for LED bulb	KWh	3.50
Unit Savings per annum	KWh	3.50
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**34.93**
Cost of LED bulb	Rs	120
Investment for LED bulb	Rs	**120**
Simple Payback period	Years	**3**

24. Retrofitting of existing ordinary and old air conditioner (1.5T) with inverter air conditioner/BEE star rated air conditioner.

Particulars	Unit	Quantity
Existing Non star AC 1.5T	kW	2.364
Proposed BEE Star Rated Inverter AC	kW	1.5
Avg No: of working hours/day	Hours	3.00
No: of working days per year	Days	250
No: of working hours per annum	Hours	750
No: of operating Non star AC	Nos	1
Annual consumption for Non star AC	KWh	1773
Annual consumption for 5 Star AC	KWh	1125
Unit Savings per annum	KWh	648
Cost per KWh(Average)	Rs	9.98
Annual financial savings	Rs	**6467**
Cost of 5 Star AC	Rs	33000
Investment for 5 Star AC	Rs	**33000**
Simple Payback period	Years	**5**

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25. Power factor optimization from 0.87 to 1

Particulars	Unit	Quantity
Average annual Recorded maximum demand	KVA	52.33
Present power factor (lagging)		0.88
Average KW Drawn	KW	46.06
KVAr required for PF Improvement to 1 from 0.88 (multiplication factor 0.54 Ref :BEE Table)	KVAr	24.87
Assumed cost per KVAr for new capacitors	Rs	900
Total Cost for Capacitors / existing repair	Rs	**22383**
Power factor after PF Optimisation (Correcting the faulty capacitors or new capacitor panel)		1
Maximum demand at 1 PF	KVA	46.06
Reduction in Maximum demand	KVA	6.27
Percentage reduction in energy charge from 0.88 to 1 PF Improvement @0.5% for every 0.01 increase	%	6
Annual Electricity consumption	KWh	128127
Monthly average electricity consumption	KWh	10677.25
Assumed per unit energy charge	Rs	6.22
Monthly average energy charge cost component	Rs	66413
Cost reduction in pf penalty/incentive per month due to pf improvement (6% of energy charge component)	Rs	3984.78
Annual Cost reduction (a)	Rs	**47818**
Monthly Cost savings by MD reduction at Rs 440/KVA	Rs	2758.8
Annual Cost savings by MD reduction at Rs 440/KVA (b)	Rs	**33105.6**
Total annual savings (a)+(b)	Rs	**80923.6**
Simple Payback period	months	4

INFERENCE

1. Annual Energy Savings of Rs 80924 is obtained at an investment of Rs 22383 which can be gained back in a payback period of 4 months.
2. The deteriorated capacitors can be replaced or repaired as per the analysis given in APFC performance assessment chart.

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OTHER RECOMMENDATIONS

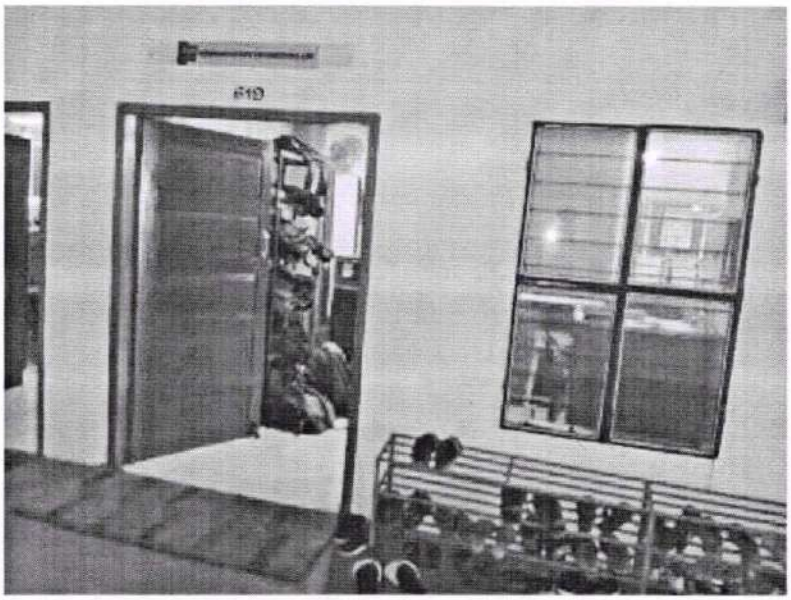

Figure 5: Air-conditioned rooms being kept open

OBSERVATION – Doors of Air-conditioned lab area is kept open while AC is switched on.

SUGGESTION–Close the doors/ensure proper air curtains are installed to prevent wastage.

Figure 6: Insufficient number of AC's

OBSERVATION – Insufficient number of split AC units for large lab areas.

SUGGESTION– Add more AC units with optimal design to ensure AC compressor cut-off at regular intervals.

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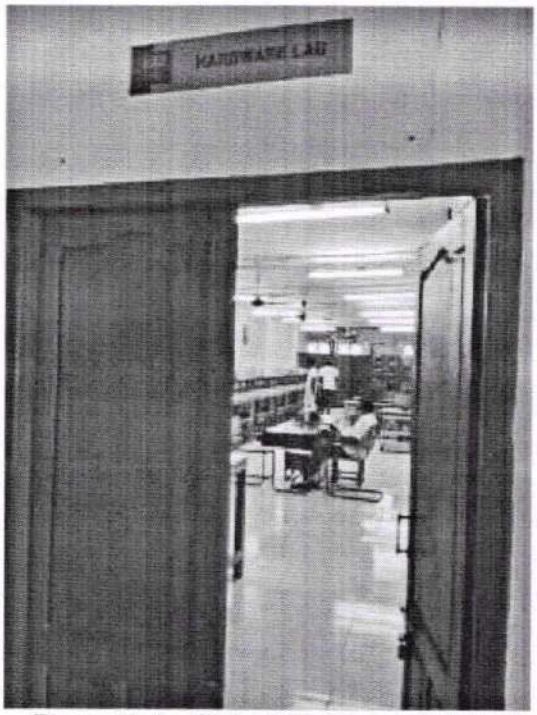

OBSERVATION – Natural ventilation and day light is blocked with cupboard and all inefficient T12 tube lights are functioning.

SUGGESTION – Ensure natural ventilation and day light is optimally used.

Figure 7: Inefficient Fluorescent tube lights in lab building

Figure 8: Lack of heat exhaust systems in lab building

OBSERVATION – High temperatures inside the lab area due to lack of heat exhaust systems and improper day light usage.

SUGGESTION–Natural draft exhaust fans can be installed which will reduce the indoor heat. There is huge potential for day light use in the lab building which can be tapped with transparent roofing sheets.

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Recommendations for Air Conditioning system:

1. Replace the inefficient ACs like non-Star split ACs, which will result in energy savings.
2. Maintenance of Air Conditioners should be done regularly to get better AC output.
3. Keep the Air Conditioned rooms air tight and avoid the temperature increase inside the room, due to the sunlight penetration by using curtains/ sun films /Low E-glass windows/multi pane windows.
4. The connection pipes of outdoor and indoor units of ACs, are to be maintained with proper insulation.
5. Existing windows can be replaced with energy efficient windows (high R value, low solar heat gain coefficient, low conductivity, low emissivity glazing, air tight etc.)
6. Set the air conditioning temperature within a range of 24-26 degree Celsius, to have better human comfort and hence to save power.
7. Create awareness among employees about the importance and practice of Energy Conservation.

Recommendations for Ventilation system:

1. Replace the existing fans with BEE 5 star labelled (BLDC) ceiling fans.
2. Fans may be cleaned regularly.
3. Switch off Fans, when not in use and adjust the regulator position to attain optimal speed.
4. Fans, once damaged and obsolete, may be replaced with new and energy efficient BEE 5 star rated fan, rather than rewinding them. Rewinding causes heat loss.
5. Utilize natural wind, to the maximum extent possible.
6. Create awareness among employees about the importance and practice of Energy Conservation.

Recommendations for lighting system:

1. Utilize Day light to maximum extent possible.
2. Replace 28W Fluorescent Tube lights (T5) with 18W LED tube.
3. Replace CFL with 14W / 7W LED bulb.
4. Clean the light fittings and Window panes regularly. A heavy coat of dust on fittings can block up to 50% of the light output.
5. For lighting control, use suitable occupancy sensors/timers/motion sensors, to get the light, as per the requirement. Lighting costs can be reduced up to 40%.
6. Switch off the energy using appliances/ equipment, when not in use.
7. Switch on only the necessary lights, as and when required. Turn off lights in unoccupied spaces.
8. Create awareness among employees about the importance and practice of Energy Conservation.

Recommendations for computers:

1. Switch off the supply to the computers at the switch board when not in use.
2. Shut down computers, when not in use, especially during lunch hours etc.

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11. CLIMATE IMPACT

Climate change is disrupting the economies and lives of people in every country in every continent. In recent years, Kerala has seen the worst changing weather patterns, rising sea levels and greenhouse gas emissions are now at the highest levels in history. Wildfires, floods and temperature rises have become a threat to the state of Kerala. Greenhouse gases dominated by Carbon di-oxide emission is the major reason for global warming and consequent climate change and carbon accounting provides a quantification of greenhouse gas emitted by the organization. In carbon accounting the major reasons of carbon emission within the organisation are identified and quantification of the weight of carbon dioxide emitted is done based on scientific calculations and standard assumptions.

Emission due to Electrical Energy Usage

Every unit of electricity consumption is associated with carbon emission according to the methods of power generation in the utility grid of the region According to Indian grid standards, 0.79 $kgCO_2$ is emitted per kWh of electricity generated.

CO_2 emissions due to electricity consumption [kg]

= Grid emission factor [kgCO2/kWh] X Electricity imported [kWh]

- Grid emission factor: The emission factor value for electricity consumption from grid is **0.79kgCO_2/kWh** according to Central Electricity Authority database.

- Consumption of the organisation:
  Annual value according to survey = **191786.02 kWh/Year**

- Total carbon emission due to energy consumption from grid = **151510.95 kgCO2.**

The CO2 emission and there by impact on environment and climate can be reduced by implementing the energy saving recommendations and utilising more renewable energy sources.

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12. ENERGY POLICY

It is recommended that the management shall take necessary steps to formulate and follow energy policy within the organization based on the international standard ISO 50001:2018 - Energy management systems - Requirements with guidance for use. The standard is applicable to any organization regardless of its type, size, complexity, geographical location, organizational culture or the products and services it provides. It provides guidelines pertaining to activities affecting energy performance that are managed and controlled by the organization Based on this standard, the organization shall:

- Establish, document, implement and maintain and improve an EnMS (Energy Management System) in accordance with the requirements of this International Standard.
- Define and document the scope and the boundaries of its EnMS
- Determine how it will meet the requirements of this international standard in order to achieve continual improvement of its energy performance and of its EnMS.

Top management shall define the energy policy and ensure that

- It is appropriate to the nature and scale of the organisation's energy use and consumption and includes a commitment to continual improvement in energy performance.
- It includes a commitment to ensure the availability of information and of necessary resources to achieve objectives and targets.
- It includes a commitment to comply with applicable legal requirements and with other requirements to which the organisation subscribes which relate to its energy use, consumption, and efficiency.
- It provides the framework for setting and reviewing energy objectives and targets
- It supports the purchase of energy efficient products and services and design for energy performance improvement.
- It is documented and communicated at all levels within the organization and regularly reviewed, and updated as necessary.

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13. RENEWABLE ENERGY INTEGRATION

Energy harvested from sun is one of the cleanest form of renewable energy available from nature. Installation of a solar plant of capacity 170kWp can generate approximately 20400 units per month, which can meet the monthly energy consumption (considering the energy consumption before pandemic) of the building.

Particulars	Value	Unit
Monthly energy demand	20000	kWh
Annual energy demand	240000	kWh
Proposed capacity of solar PV required to offset annual energy demand	170	kWp
As per the climatic condition at the location 1kWp generates 4 units/day. Hence total generation for 170kWp per day.	680	kWh
Annual energy yield	244800	kWh
Annual equivalent cost of energy generated @ Rs. 6.2 Rs/unit	1517760	INR
Investment @ 65,000/kWp	1,10,50,000	INR
Simple Pay Back Period	88	Months

*Taking annual average of solar generation for a year, 4 kWh is the generation potential per day for a 1kWp plant

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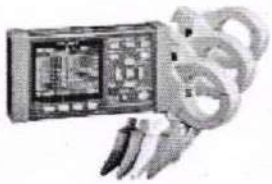
14. ANNEXURE 1: LIST OF INSTRUMENTS

List of Energy auditing instruments:

Power quality analyser (Hioki PW-3360)	
Lux meter	
Current Clamps (1000A TRMS AC/DC CLAMP W/IFLEX)	
Digital Sound Level Meter	
Thermal Imager (Testo 865)	
Handheld non-electrical tools (if required)	
PPE (if required)	

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15. ANNEXURE 2: LUX LEVEL TABLE

SL.NO	DATE	LOCATION	AVERAGE LUX LEVEL (Including day light)
		GROUND FLOOR	
1	12-02-2022	Seminar Hall	163.25
2	12-02-2022	111. Lecture Hall	108.75
3	12-02-2022	110. Lecture Hall	126.25
4	12-02-2022	108. Lecture Hall	133.75
5	12-02-2022	105. Lecture Hall	163.5
6	12-02-2022	102. Lecture Hall	198
7	12-02-2022	101. Lecture Hall	138.25
		FIRST FLOOR	
8	12-02-2022	212. Lecture Hall	111
9	12-02-2022	211. Lecture Hall	103
10	12-02-2022	209. Lecture Hall	127
11	12-02-2022	205. Lecture Hall	125.25
12	12-02-2022	202. Lecture Hall	182
13	12-02-2022	201. Lecture Hall	105.5
		SECOND FLOOR	
14	12-02-2022	316. Lecture Hall	254.5
15	12-02-2022	315. Lecture Hall	223.25
16	12-02-2022	314. Lecture Hall	276.75
17	12-02-2022	313. Lecture Hall	202.5
18	12-02-2022	312. Lecture Hall	259
19	12-02-2022	311. Lecture Hall	310.5
20	12-02-2022	310. Lecture Hall	214.75
21	12-02-2022	309. Lecture Hall	246.5
22	12-02-2022	308. Lecture Hall	203
23	12-02-2022	305. Lecture Hall	204
24	12-02-2022	304. Lecture Hall	139.5
25	12-02-2022	302. Lecture Hall	260
26	12-02-2022	301. Lecture Hall	266.5
		THIRD FLOOR	
27	12-02-2022	SJ 19	409.5
26	12-02-2022	SJ 16	374.25
27	12-02-2022	SJ 14	308.5
28	12-02-2022	SJ 5	392.5
29	12-02-2022	SJ 4	376.75

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16. ANNEXURE 3: LIST OF APPLIANCES

Sl. No.	Name of the Equipment	Nos.
1	LED TV	3
2	LED TV	1
3	Mixer Grinder	1
4	Water Purifier	8
5	Electric Kettle	1
6	Freezer	1
7	Refrigerator	1
8	Bottle Cooler	1
9	Motor – 5HP	2

17. ANNEXURE 4: LIST OF LAB EQUIPMENTS

SL.NO	LOCATION	LOAD	Wattage per appliance (kW)	No. of Appliances
	LAB BUILDING			
1	Electrical & Electronics Engg. Lab	DC Motor	3.5	1
		DC Motor - Generator Set	4.2	1
		Generator	3.7	1
		DC Motor - Generator Set	5.2	1
		DC Motor	3.7	1
		DC Motor - Alternator Set	3.7	1
		Generator	6	1
		Motor	5.6	1
		Generator	4	1
		3 phase squirrel cage induction motor	3.7	1
		1 phase induction motor	1.5	1
		3 phase slip ring induction motor	3.7	1
		1 phase transformer	2.4	1
2	Fluid mechanics & machines lab	Motor 1	0.373	1
		Motor 2	0.746	1
		Motor 3	0.746	1
		Motor 4	0.746	1
		Motor 5	0.746	1
		Motor 6	5.5	1
		Motor 7	5.5	1
		Motor 8	0.373	1
		Motor 9	0.373	1

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SL.NO	LOCATION	LOAD	Wattage per appliance (kW)	No. of Appliances
		Motor 10	0.373	1
3	Heat Engines Lab	Eddy current dynamometer	80	1
		Centrifugal blower testing	18.5	1
		Two stage air compressor testing	5.595	1
		Rotary compressor test rig	0.75	1
4	Machine tool lab	Lathe machine	2.2	18
		Universal milling machine	3	7
		Universal milling machine - feed motor	0.75	7
		Cylindrical Grinder	2.238	1
		Cylindrical Grinder	0.373	1
		Tool and cutter grinder	0.2238	1
		Surface grinder	1.492	1
		Shaping machine	1.492	18
		Radial drilling machine	1.5	1
		Hydraulic power saw	0.75	1
		Slotting machine	0.746	1
5	Basic engineering workshop	Motor	0.373	1
		Grinding machine	0.7	1
		Drilling machine	0.746	1
		Welding machine	12	1
6	601. Metrology & Metallurgy lab	Furnace	3.75	1
		Tool makers microscope	0.25	1
7	622. Hardware lab	CRO	0.04	11
8	623. Communication engineering lab	Power supply		11
		Function generator	0.02	11
9	621. CIM lab	Co-ordinate measuring machine		1
		3D Printer	2.76	1
		Milling machine	8.715	1
		Motor	1.492	1
		CNC lathe	1	1
		CNC Router	2.231	1
		UPS	4	1
		UPS	2.4	1
		Vinyl cutting machine	0.1	1
10	Strength of materials lab	Motor	0.746	1
		Universal testing machine	0.9698	1
11	604. CAD lab	UPS	4	2
		UPS	5.6	1
12	Automobile lab	Valve refacer	0.373	1
		Boring & Grinding machine	0.373	3
		Brake drum	0.75	1

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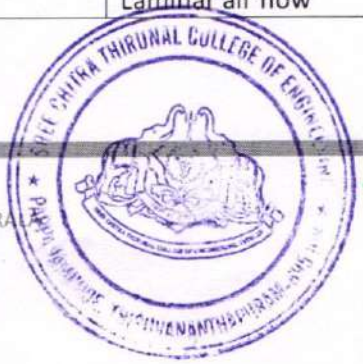
SL.NO	LOCATION	LOAD	Wattage per appliance (kW)	No. of Appliances
		Motor	0.746	1
13	808. Heat & mass transfer operations lab	Compressor	3	1
		Venturimeter	0.373	1
		Drag co-efficient apparatus	0.373	1
14	807. Environmental lab	Incubator	1.38	1
		Sieve	0.5	1
		Shaking incubator	0.5	1
		Motor	0.249	1
		Mixing vessel	0.66	1
15	806. Reaction engg. And process control lab	Isothermal batch reactor	1	1
		Continuous stirred tank reactor	1	1
		RTD studies INCSTU	1	1
		Isothermal semi batch reactor	1	1
		Water bath stirred	0.5	2
		Cascade CSTR	1	1
		Isothermal tubular reactor	1	1
		Motor	0.373	1
16	805. Downstream processing lab	Centrifuge	0.11	1
		Flocculator	0.1	1
		Motor	0.1865	1
		Vaccum oven	0.6	1
		Fluid bed dryer	0.15	1
		Shaking incubator	0.5	1
		BOD incubator	1.38	1
		Hot air oven	1.1	1
17	804. Software lab	UPS	4	1
18	803. Biochemistry lab	LPG		
		Hot air oven	1.1	1
		Cooling centrifuge	0.11	1
19	802. Microbiology lab	Hot plate	1.2	1
		Bacteriological Incubator	0.345	1
		Centrifuge	0.11	1
20	Incubation Room	BOD incubator	1.38	1
21	801. Biochemical Engg. Lab	Deep freezer	0.92	1
		Orbital shaking incubator	0.5	1
		Microwave oven	1.2	1
		Centrifuge	0.11	1
		Refridgerator - Non star	0.25	1
22	Incubation Room	Autoclave	1.5	1
		Laminar air flow	0.72	2



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18. ANNEXURE 5: LIST OF BUILDINGS

- College Building
- Lab Building
- Lab Building 2
- Canteen Block
- Post Office Building
- CGPA Building

19. ANNEXURE 6: LIST OF MANUFACTURERS

Item	Brands
LED Tube Light	Philips, Havells, Wipro, Syska
BEE Certified star rated Fan/ BLDC ceiling fan	Crompton Greaves, Havells, Luminous, Atomberg
Air Conditioner	Blue star, Voltas, Lloyd, LG, Carrier
Led Bulb	Havells, Syska, Philips, Wipro

20. ANNEXURE 7: ROOM WISE LIST OF EQUIPMENTS

- College Building

SL.NO	APPLIANCE	T12 (52W)	T12X2 (104W)	T8 (36W)	CFL (14W)	LED PANEL 2X2 (40W)	LED PANEL (15W) (SQUARE)	LED PANEL (15W) (ROUND)	LED BULB (9W)	LED TUBE (18W)	LED TUBE (18W) (SMALL)	EXHAUST FAN (60W)	EXHAUST FAN (40W) (40W)	PEDESTAL FAN (55W)	WALL FAN (50W)	CEILING FAN (60W)	nos.COMPUTER (120W)
	Name of Building/Room/Place/Area /Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	
	GROUND FLOOR																
1	Staff Room - CS	2								2						3	1
2	Toilet								4								
3	Corridor	2															
4	Ladies Toilet	1							4			4					
5	Staff Room - EC									4						4	1
6	Toilet	1			1												
7	HOD - Applied Science	2														2	
8	Toilet								1			1					

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SL.NO	APPLIANCE	T12 (52W)	T12X2 (104W)	T8 (36W)	CFL (14W)	LED PANEL 2X2 (40W)	LED PANEL (15W) (SQUARE)	LED PANEL (15W) (ROUND)	LED BULB (9W)	LED TUBE (18W)	LED TUBE (18W) (SMALL)	EXHAUST FAN (60W)	EXHAUST FAN (40W) (40W)	PEDESTAL FAN (55W)	WALL FAN (50W)	CEILING FAN (60W)	nos.COMPUTER (120W)
	Name of Building/Room/Place/Area /Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	
9	114. Lecture Hall	1	4													7	
10	113. Exam Control Room	2	7													5	5
11	112. Seminar Hall						19										
12	Corridor	1															
13	Central Library	19	4											1	2	18	24
14	Central Library - First Floor	27														22	1
15	120. Digital Library	3													2		
16	Technical Section	2														2	
17	Staff Room	1														1	
18	Toilet								1			1					
19	Librarian	1														1	
20	Toilet								1			1					
21	Entrance		5														
22	Outdoor - Entrance									5							
23	111. Lecture Hall	3								2						7	
24	110. Lecture Hall	3								2						7	
25	Passage	4															
26	Skill Delivery Platform Kerala					20		2									
27	108. Lecture Hall	3								2						7	
28	107. HOD - Dept. of EC									4						2	1
29	Toilet								1		1	1					
30	106. Staff Room - EC	1								4					1	4	1
31	Toilet	1							1								
32	105. Lecture Hall	5														7	
33	104. Seminar Hall						8								8		
34	103. Gents Toilet	2							4			1					
35	102. Lecture Hall	1								4						7	
36	101. Lecture Hall	2								2						7	
	FIRST FLOOR																
37	Stair	4															
38	Ladies Toilet	2										3					
39	220. Dept. Library EC	2														2	
40	219. Staff Room ME	2														7	1
41	218. Staff Room ME	3	1													6	
42	Toilet	1										1					

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SL.NO	APPLIANCE	T12 (52W)	T12X2 (104W)	T8 (36W)	CFL (14W)	LED PANEL 2X2 (40W)	LED PANEL (15W) (SQUARE)	LED PANEL (15W) (ROUND)	LED BULB (9W)	LED TUBE (18W)	LED TUBE (18W) (SMALL)	EXHAUST FAN (60W)	EXHAUST FAN (40W) (40W)	PEDESTAL FAN (55W)	WALL FAN (50W)	CEILING FAN (60W)	COMPUTER (120W)
	Name of Building/Room/Place/Area /Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.
43	Passage	13	3														
44	217. HOD Dept. of Biotechnology & Biochemical Eng.	1								2						2	1
45	Toilet								1		1	1					
46	214. Office	4														4	3
47	Store Room	2														1	
48	Toilet	1										1					
49	Office	2	5													8	6
50	Administrative Officer	2														1	1
51	213. Principal Room - Waiting Area	7														3	1
52	Principal Room		9												3		1
53	Passage	1													1		
54	Room		1												1		
55	Toilet	1							1			1					
56	212. Lecture Hall	1	4													7	
57	211. Lecture Hall		4													7	
58	210. Seminar Hall ME						15								6		
59	209. Lecture Hall	1	4													7	
60	208. HOD - Mechanical Engg.	2														2	1
61	Toilet	1							1			1					
62	207. Staff Room ME	4													1	4	2
63	Toilet	1							1			1					
64	Dept. Library ME	2														2	
65	205. Lecture Hall	1	4													7	
66	204. Dept. Library BT	2														2	
67	203. Gents Toilet	2							4			4					
68	202. Lecture Hall	1	4													7	
69	201. Lecture Hall		3													7	
	SECOND FLOOR																
70	Stair	4															
71	320. Toilet - Ladies	2							4			4					
72	Passage	10	2														
73	Seminar Hall - BT																
74	318. Staff Room - BT	4														4	

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SL.NO	APPLIANCE	T12 (52W)	T12X2 (104W)	T8 (36W)	CFL (14W)	LED PANEL 2X2 (40W)	LED PANEL (15W) (SQUARE)	LED PANEL (15W) (ROUND)	LED BULB (9W)	LED TUBE (18W)	LED TUBE (18W) (SMALL)	EXHAUST FAN (60W)	EXHAUST FAN (40W) (40W)	PEDESTAL FAN (55W)	WALL FAN (50W)	CEILING FAN (60W)	nos.COMPUTER (120W)
	Name of Building/Room/Place/Area /Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	
75	Toilet	1							1			1					
76	317. Staff Room - Electrical	2								1					1	2	1
77	Toilet	1							1			1					
78	316. Lecture Hall	1	4													5	
79	315. Lecture Hall	5		1												7	
80	314. Lecture Hall	5														7	
81	313. Lecture Hall	5														7	
82	312. Lecture Hall	5														5	
83	311. Lecture Hall	5														7	
84	310. Lecture Hall	5														7	
85	309. Lecture Hall	5														7	
86	308. Lecture Hall	1	4													7	
87	307. HOD Dept. of Computer Science & Engg.									2						2	1
88	Toilet	1							1			1					
89	306. Staff Room - Civil	2														2	
90	Toilet	1							1			1					
91	305. Lecture Hall	1	4													7	
92	304. Lecture Hall	1	4													7	
93	Gents Toilet	2							4			1					
94	302. Lecture Hall		4													7	
95	301. Lecture Hall	1	4													7	
	THIRD FLOOR																
96	Toilet							7			1		5				
97	Passage									27							
98	SJ 19							8								4	
99	SJ 18							12								4	
100	Toilet							1			1		1				
101	SJ 17							6								2	1
102	SJ 16							12								6	
103	SJ 15 - Microwave Engg. Lab							12								6	
104	SJ 14							12								4	
105	SJ 13							12								4	

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SL.NO	APPLIANCE	T12 (52W)	T12X2 (104W)	T8 (36W)	CFL (14W)	LED PANEL 2X2 (40W)	LED PANEL (15W) (SQUARE)	LED PANEL (15W) (ROUND)	LED BULB (9W)	LED TUBE (18W)	LED TUBE (18W) (SMALL)	EXHAUST FAN (60W)	EXHAUST FAN (40W) (40W)	PEDESTAL FAN (55W)	WALL FAN (50W)	CEILING FAN (60W)	COMPUTER (120W)
	Name of Building/Room/Place/Area /Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.
106	SJ 12							12								5	
107	SJ 11, 10							24								8	
108	SJ 9							12								6	
109	SJ 8							9								4	
110	SJ 7							12								4	
111	Toilet							2			1		1				
112	SJ 6							6								2	
113	Toilet							1			1		1				
114	SJ 5							12								4	
115	SJ 4							12								4	
116	Gents Toilet							8			1		4				
117	SJ 2							24								8	

SL. NO	APPLIANCE	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	NON STAR AC 1.5T			NON STAR AC 1T			AC 2T			AC 1.5T			LED TV (50W)	LED TV (80W)	XEROX (920W)	WATER PURIFIER (50W)
	Name of Building/Room/Place /Area/Location	nos.	nos.	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	nos.	nos.	nos.
	GROUND FLOOR																			
1	Staff Room - CS																			
2	Toilet																			
3	Corridor																			1
4	Ladies Toilet																			
5	Staff Room - EC	6																		
6	Toilet																			
7	HOD - Applied Science																			
8	Toilet																			
9	114. Lecture Hall			1																

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SL. NO	APPLIANCE	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	NON STAR AC 1.5T			NON STAR AC 1T			AC 2T			AC 1.5T			LED TV (50W)	LED TV (80W)	XEROX (920W)	WATER PURIFIER (50W)
	Name of Building/Room/Place /Area/Location	nos.	nos.	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	nos.	nos.	nos.
10	113. Exam Control Room		1														2			
11	112. Seminar Hall									6										
12	Corridor																			1
13	Central Library																			
14	Central Library - First Floor																			
15	120. Digital Library										3	2	1							
16	Technical Section																			
17	Staff Room																			
18	Toilet																			
19	Librarian																			
20	Toilet																			
21	Entrance																			
22	Outdoor - Entrance																			
23	111. Lecture Hall			1																
24	110. Lecture Hall			1																
25	Passage																			
26	Skill Delivery Platform Kerala	59											4					1		
27	108. Lecture Hall			1																
28	107. HOD - Dept. of EC		1				1													
29	Toilet																			
30	106. Staff Room - EC																			
31	Toilet																			
32	105. Lecture Hall			1																
33	104. Seminar Hall			1									1							
34	103. Gents Toilet																			
35	102. Lecture Hall			1																
36	101. Lecture Hall			1																
	FIRST FLOOR																			
37	Stair																			
38	Ladies Toilet																			1
39	220. Dept. Library EC																			
40	219. Staff Room ME		1																	
41	218. Staff Room ME																			
42	Toilet																			
43	Passage																			1

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SL. NO	APPLIANCE	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	NON STAR AC 1.5T			NON STAR AC 1T			AC 2T			AC 1.5T			LED TV (50W)	LED TV (80W)	XEROX (920W)	WATER PURIFIER (50W)
	Name of Building/Room/Place /Area/Location	nos.	nos.	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	nos.	nos.	nos.
44	217. HOD Dept. of Biotechnology & Biochemical Eng.		1				1													
45	Toilet																			
46	214. Office		2																	
47	Store Room																			
48	Toilet																			
49	Office		5																1	
50	Administrative Officer		1																	
51	213. Principal Room - Waiting Area		2																	
52	Principal Room		1	1							3		3				1			
53	Passage																			
54	Room																			
55	Toilet																			
56	212. Lecture Hall			1																
57	211. Lecture Hall			1																
58	210. Seminar Hall ME			1										3		3				
59	209. Lecture Hall			1																
60	208. HOD - Mechanical Engg.		1				1													
61	Toilet																			
62	207. Staff Room ME																			
63	Toilet																			
64	Dept. Library ME	1																		
65	205. Lecture Hall			1																
66	204. Dept. Library BT																			
67	203. Gents Toilet																			
68	202. Lecture Hall			1																
69	201. Lecture Hall																			
	SECOND FLOOR																			
70	Stair																			
71	320. Toilet - Ladies																			
72	Passage																			
73	Seminar Hall - BT																			
74	318. Staff Room - BT																			
75	Toilet																			
76	317. Staff Room - Electrical		1																	
77	Toilet																			

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SL. NO	APPLIANCE	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	NON STAR AC 1.5T			NON STAR AC 1T			AC 2T			AC 1.5T			LED TV (50W)	LED TV (80W)	XEROX (920W)	WATER PURIFIER (50W)
	Name of Building/Room/Place /Area/Location	nos.	nos.	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	nos.	nos.	nos.
78	316. Lecture Hall			1																
79	315. Lecture Hall			1																
80	314. Lecture Hall			1																
81	313. Lecture Hall			1																
82	312. Lecture Hall			1																
83	311. Lecture Hall			1																
84	310. Lecture Hall			1																
85	309. Lecture Hall			1																
86	308. Lecture Hall			1																
87	307. HOD Dept. of Computer Science & Engg.	1					1													
88	Toilet																			
89	306. Staff Room - Civil																			
90	Toilet																			
91	305. Lecture Hall			1																
92	304. Lecture Hall			1																
93	Gents Toilet																			
94	302. Lecture Hall			1																
95	301. Lecture Hall			1																
	THIRD FLOOR																			
96	Toilet																			
97	Passage																			1
98	SJ 19																			
99	SJ 18																			
100	Toilet																			
101	SJ 17																			
102	SJ 16																			
103	SJ 15 - Microwave Engg. Lab			1							4	2	2							
104	SJ 14																			
105	SJ 13																			
106	SJ 12													3	1.5	2				

SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING

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SL. NO	APPLIANCE	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	NON STAR AC 1.5T			NON STAR AC 1T			AC 2T			AC 1.5T			LED TV (50W)	LED TV (80W)	XEROX (920W)	WATER PURIFIER (50W)
	Name of Building/Room/Place /Area/Location	nos.	nos.	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	nos.	nos.	nos.
107	SJ 11, 10													4	1.5	2				
108	SJ 9			1																
109	SJ 8																			
110	SJ 7																			
111	Toilet																			
112	SJ 6																			
113	Toilet																			
114	SJ 5																			
115	SJ 4																			
116	Gents Toilet																			
117	SJ 2																			

SREE CHITRA THIRUNAL COLLEGE OF ENGINEERING

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- Lab Building

SL.NO	APPLIANCE	T12 (52W)	T12x2 (104W)	T8 18W	LED SPOT (12W)	CFL 70W	LED PANEL (15W)	LED BULB (9W)	LED TUBE (18W)	EXHAUST FAN (60W)	PEDESTALFAN (55W)	PEDESTAL FAN (200W)	PEDESTAL FAN (180W)	WALL FAN (50W)	WALL FAN 80W	CEILING FAN (60W)
	Name of Building/Room/Place/Area/Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.
	LAB BUILDING															
1	Electrical Engg. Workshop							1	3							3
2	Electrical & Electronics Lab		7												3	3
3	Lab-in-charge								2					1		
4	Fluid Mechanics & Machines Lab		6						1							5
5	FM lab room								4							2
6	Toilet							1								
7	Staff Room								1							
8	Heat Engines Lab								2							2
9	Lab area	1	1						6							
10	Machine tool lab	19	6									1	2			3
11	Staff Room 2	4														3
12	Staff Room 1	4														4
13	Toilet	1														
14	Basic engineering workshop		16									3				12
15	Toilet	2								2						
16	Toilet - Ladies															1
17	Soil testing lab		1													1
18	Engineering chemistry lab	4									2					6
19	Store	1	1													1
20	Staff Room	1													2	
21	601. Metrology & Metallurgy lab	4	5													
22	622. Hardware lab	11							4					1		6
23	623. Communication engineering lab				12				2					7		
24	621. CIM lab	7														
25	Drawing hall		9			6										9
26	Strength of materials lab	1	3													
27	604. CAD lab	2	10													
28	603. Research Lab								5					1		
29	Store								1							
30	Research Lab Entrance								2					2		
31	605. Workshop Superintendent								3							2
32	Automobile lab	3	2													1

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SL.NO	APPLIANCE	T12 (52W)	T12x2 (104W)	T8 18W	LED SPOT (12W)	CFL 70W	LED PANEL (15W)	LED BULB (9W)	LED TUBE (18W)	EXHAUST FAN (60W)	PEDESTALFAN (55W)	PEDESTAL FAN (200W)	PEDESTAL FAN (180W)	WALL FAN (50W)	WALL FAN 80W	CEILING FAN (60W)
	Name of Building/Room/Place/Area/Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.
33	Room	1														
34	Vehicle system lab	11	8													8
35	609. Vehicle testing lab	5														1
36	808. Heat & mass transfer operations lab								7					3		3
37	807. Environmental lab	5	2													5
38	806. Reaction engg. And process control lab		8							1						6
39	Room	2	1													2
40	Room 2	1														
41	Store	1														
42	805. Downstream processing lab	9														5
43	Room		2											2		
44	804. Software lab						12				1			4		
45	803. Biochemistry lab	8												4		
46	802. Microbiology lab	4	2						4	1						
47	Incubation Room	1	1	8												
48	Store	1														
49	Passage	2														
50	801. Biochemical Engg. Lab	4	3								1					7
51	Store	1														
52	Incubation Room	2														1
53	Dark room	1														

SL. NO	APPLIANCE	COMPUTER (120W)	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	WINDOW AC		NON STAR AC 1.5T		AC 2T			AC 1.5T			ELECTRIC KETTLE (1500W)	REFRIDGERATOR (136W)		WATER PURIFIER (50W)
	Name of Building/Room/Place/ Area/Location	nos.	nos.	nos.	nos.	rating	nos.	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	rating	nos.	nos.
	LAB BUILDING																		

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SL. NO	APPLIANCE	COMPUTER (120W)	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	WINDOW AC		NON STAR AC 1.5T		AC 2T			AC 1.5T			ELECTRIC KETTLE (1500W)	REFRIDGERATOR (136W)		WATER PURIFIER (50W)
	Name of Building/Room/Place/ Area/Location	nos.	nos.	nos.	nos.	rating	nos.	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	rating	nos.	nos.
1	Electrical Engg. Workshop																		
2	Electrical & Electronics Lab																		
3	Lab-in-charge																		
4	Fluid Mechanics & Machines Lab																		
5	FM lab room		1																
6	Toilet																		
7	Staff Room																		
8	Heat Engines Lab																		
9	Lab area																		
10	Machine tool lab																		
11	Staff Room 2																		
12	Staff Room 1																		
13	Toilet																		
14	Basic engineering workshop																		
15	Toilet																		
16	Toilet - Ladies																		
17	Soil testing lab																		
18	Engineering chemistry lab																		
19	Store	1		1												1			
20	Staff Room																		
21	601. Metrology & Metallurgy lab									3	2	2							
22	622. Hardware lab	12																	
23	623. Communication engineering lab									3	2	2							
24	621. CIM lab																		
25	Drawing hall																		
26	Strength of materials lab																		
27	604. CAD lab	40			1				1					1.5	1				
28	603. Research Lab												3	1.5	1				
29	Store																		

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SL. NO	APPLIANCE	COMPUTER (120W)	LAPTOP (120W)	PRINTER	PROJECTOR (500W)	WINDOW AC		NON STAR AC 1.5T		AC 2T			AC 1.5T			ELECTRIC KETTLE (1500W)	REFRIDGERATOR (136W)		WATER PURIFIER (50W)
	Name of Building/Room/Place/ Area/Location	nos.	nos.	nos.	nos.	rating	nos.	ton	nos.	rating	ton	nos.	rating	ton	nos.	nos.	rating	nos.	nos.
30	Research Lab Entrance																		
31	605. Workshop Superintendent	1		1															
32	Automobile lab																		
33	Room																		
34	Vehicle system lab																		1
35	609. Vehicle testing lab																		
36	808. Heat & mass transfer operations lab																		
37	807. Environmental lab						2												
38	806. Reaction engg. And process control lab																		
39	Room	2		1															
40	Room 2																		
41	Store																		
42	805. Downstream processing lab	1		1			2												
43	Room																		
44	804. Software lab	14		1			1												
45	803. Biochemistry lab																5	1	
46	802. Microbiology lab																		
47	Incubation Room																		
48	Store																		
49	Passage																		
50	801. Biochemical Engg. Lab						2												
51	Store																		
52	Incubation Room						1												
53	Dark room																		

- Lab Building 2

PRINCIPAL
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SL.NO	APPLIANCE	T12 (52W)	LED PANEL (15W)	LED TUBE (18W)	WALL FAN (50W)	CEILING FAN (60W)	COMPUTER (120W)	PROJECTOR (500W)	NON STAR AC 2T		AC 2T			AC 1.5T		
	Name of Building/Room/Place/Area/Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	ton	nos.	rating	ton	nos.	rating	ton	nos.
	LAB BUILDING 2															
	GROUND FLOOR															
1	701. Embedded systems lab (PG) - Server room	3					1							3	1.5	1
2	Lab area		8		2		14	1						3	1.5	1
3	702. Embedded systems lab (UG)		12	3	4			1	2	1	3	2	1			
4	Toilet - Ladies	1														
5	Toilet - Gents	1														
	FIRST FLOOR															
6	Stair	1														
7	Room	1														
8	705. Boys common room	2				2										
9	706. Electronics circuits lab			9		8										

- Canteen Building

SL. NO	APPLIANCE	T12 (52W)	T12x2 (104W)	CFL (14W)	LED PANEL (15W)	LED TUBE (18W)	EXHAUST FAN (60W)	WALL FAN (50W)	CEILING FAN (60W)	COMPUTER (120W)	PRINTER	NON STAR AC		AC			MIXER GRINDER (500W)	WATER DISPENSER (50W)	FREEZER 136W	BOTTLE COOLER (200W)
	Name of Building/Room/Place /Area/Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	ton	nos.	rating	ton	nos.	nos.	nos.	nos.	nos.
	CANTEEN BUILDING																			
	GROUND FLOOR																			
1	Canteen					11			7										1	1
2	Dining hall					2	1		2									1		
3	Kitchen		2				1										1			
4	Entrance	1																		
	FIRST FLOOR																			
5	Stair	1																		

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SL. NO	APPLIANCE	T12 (52W)	T12x2 (104W)	CFL (14W)	LED PANEL (15W)	LED TUBE (18W)	EXHAUST FAN (60W)	WALL FAN (50W)	CEILING FAN (60W)	COMPUTER (120W)	PRINTER	NON STAR AC		AC			MIXER GRINDER (500W)	WATER DISPENSER (50W)	FREEZER 136W	BOTTLE COOLER (200W)
	Name of Building/Room/Place /Area/Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	ton	nos.	rating	ton	nos.	nos.	nos.	nos.	nos.
6	419. Central computing facility (CCF)		12		2					52				3	2	3				
7	Server room													3	2	2				
8	417. Advanced system lab		10	3						40	1			3	2	3				
9	420. Programming lab		6					2		21				3	2	1				
10	Room 2		6					2		16				3	2	1				
11	415. Database lab		6					3		35				3	2	1				
12	Room									1	1	1.5	1							
13	418. Project lab	2	2						4	20				3	2	1				
14	Staff Room	2							1											
15	Staff Room	1						1												
16	Battery Room			1																
17	Passage	1																		
18	613. Mechatronics lab	4						1	3	21				5	2	2				
	SECOND FLOOR																			
19	401. Staff room - applied science								2											
20	402. Department library	2							1											
21	Seminar hall													3	2	2				
22	402. Lecture hall	4							4											
23	Research scholars	1							1											
23	Passage	4																		
24	Room no 404					4		2	1											
25	403. Lecture hall	6							6											
26	407A. Lecture hall	3							3											
27	407B. Lecture hall	3							3											
28	Room no 4.6					8			8											
29	411. Engg. Physics lab					6			4											
30	Toilet	2				1														

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- Post Office Building

SL.NO	APPLIANCE	T12 (52W)	T8 (36W)	LED BULB (9W)	LED TUBE (18W)	WALL FAN (50W)	CEILING FAN (60W)	COMPUTER (120W)	PRINTER	PROJECTOR (500W)	NON STAR AC		STAR AC		
	Name of Building/Room/Place/Area/Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	ton	nos.	rating	ton	nos.
	POST OFFICE BUILDING														
	GROUND FLOOR														
1	Post Office	6					5	3	2						
2	Secuirity Room	1					1								
3	Ladies common room				2		3								
4	Toilet			1											
5	Outdoor				1										
6	Medical Room				2	1	1								
7	Toilet			1											
8	Outdoor				1										
	FIRST FLOOR														
9	Lab				5		3	14		1			3		2
10	Lecture hall	4					2								
11	Toilet			1											
12	Lab				1			5			1.5	1			
13	Entrance	2													
	OUTDOOR														
14	Security cabin						1								
15	Substation Room	1	3												

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- CGPU Building

SL.NO	APPLIANCE	T12x2 (104W)	LED PANEL – ROUND (15W)	CFL (14W)	LED BULB (9W)	PEDESTAL FAN (55W)	WALL FAN (50W)	COMPUTER (120W)	PRINTER	AC 1.5T		AC NON STAR		WATER DISPENSER (50W)
	Name of Building/Room/Place/Area/ Location	nos.	nos.	nos.	nos.	nos.	nos.	nos.	nos.	rating	ton	nos.	ton	nos.	nos.
	CAREEER GUIDANCE AND PLACEMENT UNIT OFFICE														
1	Entrance - outdoor	7													
2	Entrance		7			1		1	1	5	1.5	1			1
3	Room 1						1								
4	Toilet - Gents			1	1										
5	Toilet - Ladies				1										
6	Office EDC SCTCE		1				1								
7	Counselling room 1		1								1.5	1			
8	Counselling room 2		1												
9	Counselling room 3		1								1.5	1			
10	Counselling room 4		1												
11	Counselling room 5		1												
12	Office		2				1	1					1.5	1	

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