ENERGY AUDIT - 2023

COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

KALAMASSERY, ERNAKULAM

EXECUTED BY

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

Every institution should be imparting knowledge about the campus environment and its surroundings through activities that follows the principles of sustainability. An energy audit is essential first step to reduce energy cost and greenhouse emissions. Audit is defined as a systematic and implement examination of data statements, records, operations and performance of an enterprise for a purpose. Energy audits is a systematic study or survey to identify how energy being used in its own facility. And identifying the energy savings opportunities in the building Behavioural Change through the student education can provide greatest benefit at least cost. Even small savings in each house holds make dramatic change in the society and for nation. The idea of energy conservation and sustainability will be percolated to society through students will have long standing effect and successful too.

This report is compiled by the BEE certified energy auditor along with the project engineers who are experienced in the field of energy, environment and management.

ACKNOWLEDGEMENTS

We express our sincere gratitude to Cochin University of Science and Technology for giving us an opportunity to carry out the project of Energy Audit. We are extremely thankful to management and all the staffs for their support to carry out the studies and for input data, and measurements related to the project of Energy Audit.

Also mentioning our Energy audit team members for successfully completing the assignment in time and making their best efforts to add value.

ENERGY AUDIT TEAM

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2. **Mr. Jaideep P P**
   Senior Project engineer

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   Project engineer

Yours faithfully

Managing Director
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EXECUTIVE SUMMARY

I. ENERGY SAVING PROPOSALS

TABLE 1: ENERGY SAVING PROPOSALS

Sl.	Energy conservation measures	Annual Energy Savings	Annual Financial Savings	Investment	Simple payback period
		kWh	Rs	Rs	Months
1	Power factor Improvement in electrical system	-	4,81,487	1,00,000	02
2	Replacement of fluorescent light fittings with LED lights	12,499	1,05,618	1,44,000	16
3	Replacement of Low -star rated AC's with 5 star rated AC's	76978	6,50,333	17,88,000	33
4	Replacement of Ceiling fans(60W) with BLDC fans 5 star rated(28W) – 350 nos	20,832	1,76,030	12,25,000	84
Total Savings		**110309**	**1413468**	**3257000**	**28**

II. PRESENT ANNUAL ENERGY CONSUMPTION

The present annual energy consumption has been analysed in table below with the available data from the college for the period Dec 2021 to Nov 2022.

TABLE 2: ANNUAL ENERGY CONSUMPTION

Particulars	Unit	Quantity	Gross calorific value (kCal)	Million kCal (Toe)
Electricity (KSEBL)	kWh	3192540	860	**274.56**

III. PRESENT ANNUAL ENERGY COST

Annual cost for energy consumption for the period Dec 2021 to Nov 2022.

TABLE 3: ANNUAL ENERGY COST

Particulars	Unit	Quantity	Average Cost/unit	Average Cost in Lakhs (Rs)
Electricity (KSEBL)	kWh	3192540	8.45	269.77

IV. ENERGY AUDIT SUMMARY & RECOMMENDATIONS

The summary of the report with respect to each section is as follows.

1. **Baseline energy performance:**

   Electricity consumption analysis

- **Demand analysis:** The recorded maximum demand was found to be 1042 kVA which is 115.78% of the contract demand. RMD came as more than contract demand in 5 months for last year. Excess demand charges are also coming in that periods.
- **Power factor**: The PF varies from 0.96 to 0.99 during Dec 2021 to Nov 2022.
- **Sub-metering:** Sub metering of water in the major usage areas are to be provided for better control. Also records shall be kept for all the sub meter to under stand the variation in the consumption pattern in each section.
- **Modification in water distribution system**: Utilization of the terrain benefit for rain water collection in roofs of the buildings and thereby the provision for effective usage of the water.
  Use advanced taps in wash basins in canteen, kitchen etc. for reducing and controlling water usage.
  Change in flesh system in departments (Dual flesh) for reduction in water consumption.
  Around 30 KL of treated water is not using in the college.
- **Ceiling fan loads:** Ceiling fans are installed in majority of the areas by replacing it with Brushless DC fans which consumes in the range of 25 to 30W at full speed, instead of 60 -70W in normal fans, will reduce the power consumption considerably. Also, while purchasing new fans priority should be given for BLDC
- **AC loads:** Replace the continuously working AC's with 5 star rated AC. Setting temperature of the AC's should be 24-25^{o}C.
- **Light Loads:** Replace the fluorescent tubes with LED lights. Motion sensors should be provided for the toilets.

2. **Behavioral Changes**

- Use of student volunteers for reducing electricity consumption in college
- Encourage student projects in connection with energy conservation areas such as in renewable energy area, use of terrain advantage of college buildings, automatic system for control the light, fan and air conditioning requirements
- Proper recording of log books, consumption of fuel (Electricity, LPG) to be maintained by facility manager. Along with this a facility management to be formed and the committee headed by Principal or any deputed person and the committee members include the persons from academics, students, PTA, Administration and facility engineer for verification

V. ENERGY PERFORMANCE INDEX (EPI)

EPI was based on the energy consumption in Dec 2021 - Nov 2022. The projected energy consumption after the implementation of energy saving proposals is given in the table below.

TABLE 4: ENERGY PERFORMANCE INDEX

Sl. No:	Energy Performance and climate impact	Unit	Baseline	Projection	Savings (%)
1	Annual Electricity Consumption	kWh	3192540	3082231	3.46
2	Annual Electricity Consumption	TOE	274.56	265.07	3.46
3	Annual Energy Cost	Rs in lakhs	314.02	305.59	2.68
4	Annual Carbon Footprint-Electricity	Ton CO_2	2522.11	2434.96	3.46

Note: Unit conversions:

TOE = 10 million kCal (BEE energy audit manual)

MWh of electricity = 0.79 Ton of CO_2 (www.cea.gov.in)

Ton of LPG = 2.99 Ton of CO_2 (www.cea.gov.in)

Ton of Diesel = 2.4 Ton of CO_2 (www.cea.gov.in)

Ton of Wood = 1.54 Ton of CO_2 (www.cea.gov.in

kWh of electricity = 860 kCal (BEE energy audit manual)

Kilogram of LPG = 10500 kCal (BEE energy audit manual)

Liters of Diesel = 9500 kCal (BEE energy audit manual)

VI. CARBON FOOT PRINT

Carbon footprint often used as short hand for carbon emission (usually in Tones) being emitted by an activity or by institution; this is an important component in ecological footprint or the depicting the biological space reduction in the earth. Various environment protection and energy conservation connected with carbon footprint. Institution took its accountability to protect nature and taken few steps for the carbon neutral campus.

TABLE 5 CARBON FOOT PRINT

Particulars	Energy consumption reduction (kWh)	Carbon Emission reduction (Ton CO_2)	% of total
Replacement of 3000 nos : T8 tubes with 18W LED tube	90,720	63.50	96.89
Replacement of 28 nos : Ceiling fans with 30W BLDC fans	1,411	0.99	1.51
By using natural light ingression into the class rooms	1,000	0.70	1.07
Natural ventilation in the class rooms reduces the usage of fans	5,00	0.35	0.53
Total	***93,631***	***66***	***100***

INTRODUCTION

I. ENERGY AUDIT

An energy audit is a key to assessing the energy performance of an energy consuming facility and for developing an energy management program. The typical steps of an energy audit are:

- Preparation and planning
- Data collection and review
- Plant surveys and system measurements
- Observation and review of operating practices
- Data documentation and analysis
- Reporting of the results and recommendations

1.1. Definition of energy auditing

In the Indian Energy Conservation Act of 2001 **(BEE 2008)**, an energy audit is defined as: **"The verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption."**

1.2. Objectives of Energy Auditing

The objectives of an energy audit can vary from one plant to another. However, an energy audit is usually conducted to understand how energy issued within the plant and to find opportunities for improvement and energy saving. Sometimes, energy audits are conducted to evaluate the effectiveness of an energy efficiency project or program. In Cusat as per the request from the institution, we have assessed the energy consumption and saving opportunities at present scenario.

Methodology for the study

The methodology adopted for energy audit starts from historical energy data analysis, power quality analysis, monitoring of operational practices, system evaluation, cost benefit analysis of the energy conservation opportunities, and prepare plan for implementation. The proposals given in the report includes economical energy efficiency measures to reduce facilities unnecessary energy consumption and cost. The energy conservation options, recommendations and cost benefit ratio, indicating payback period are included in this report.

Scope of Work

The Scope of Work includes:

1. Historical energy data analysis.
2. Electrical, Mechanical and Thermal energy analysis.
3. Power Quality Analysis.
4. Identification of Energy saving opportunities.
5. Cost Benefit Analysis.

II. COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

Cochin University of Science and Technology (CUSAT) was initially constituted as the University of Cochin through an Act of Kerala Government on 10th July 1971. The University of Cochin was re-constituted as Cochin University of Science and Technology (CUSAT) in February 1986, redefining its objectives as "promoting Graduate and Post-Graduate studies and Advanced Research in Applied Sciences, Technology, Industry, Commerce, Management and Social Sciences." CUSAT is now a world-ranking university with the specific purpose of developing higher education, emphasizing post-graduate studies and research in applied science, technology, industry, humanities, and commerce. CUSAT has consecutively been figured in the Times Higher Education World Ranking since 2017. The Times ranks around 1500 best universities worldwide annually with around 60 universities from India out of 967. CUSAT has also found a place in the QS World University Ranking and the National Institutional Ranking Framework (NIRF) of the India Government.

Cast in the mold of a federal University, CUSAT is now a premier Science and Technology University in the country, re-accredited with NAAC 'A' Grade. During the intervening four and half decades, CUSAT has made quantum leaps in its academic pursuits and has spread its wings far and wide, encompassing the novel and emerging realms of the horizon of knowledge. The University has entered into several collaborative ventures with reputed Universities and Institutions worldwide. Scores of National and International academic discourses, seminars, workshops, etc., are held in the University every year, providing opportunities to the student community to update themselves in their respective fields of study. The Advanced Centre for Atmospheric Radar Research (ACARR), one among the many Centres of excellence of CUSAT, is included in the Prime Minister's "Make in India Program." UGC/AICTE approves all the Academic Programmes of CUSAT. With the active support of the Government of Kerala and various Central agencies and international collaborations, the University is poised to scale new heights in the years to come. The research activities are supported and funded by the Central Government agencies like UGC, DST, DBT, MHRD, etc., as well as by various international research partners through various MoUs.

True to Kerala's legacy of being the friendliest state with an avowed dedication to education, CUSAT is home for students from across the globe. The University takes pride in the fact that it has an envious record in campus recruitments. The pool of its highly successful and talented alumni, who adorn vital positions in several highly acclaimed R & D institutions and corporates in India and abroad, are the living testimony of the academic excellence of CUSAT.

VISION

The university aims to become an institution of global standard by continuously improving its quality of academic activities, taking up research and innovation in the frontier areas by ensuring conductive state –of –the –art infrastructure facilities.

MISSION

CUSAT will continuously strive to generate a human resource of global competence by imparting most modern knowledge and training to its student community and to take up Research and Development activities in the frontier areas so as to contribute positively to the progress of the society and the Nation. The University shall have the following objectives as its mission:

1. to encourage and promote research and innovation in applied science, technology, industry, commerce, management and social science for the advancement of knowledge and for the betterment of society;
2. to provide facilities and offer opportunities for graduate and post-graduate education in applied science, technology, industry, commerce, management and social science by instruction, training, research, development, innovation and extension and by such other means as the University may deem fit;
3. to devise and implement programmes of education in applied science, technology, industry, commerce, management and social science that are relevant to the changing needs of society, in terms of breadth of diversity and depth of specialization;
4. to serve as a centre for fostering co-operation and exchange of ideas between the academic and research community on the one hand and industry on the other;
5. to organize exchange programmes with other institutions of repute in India and abroad with a view to keeping abreast of the latest innovation and developments in relevant areas of teaching and research.

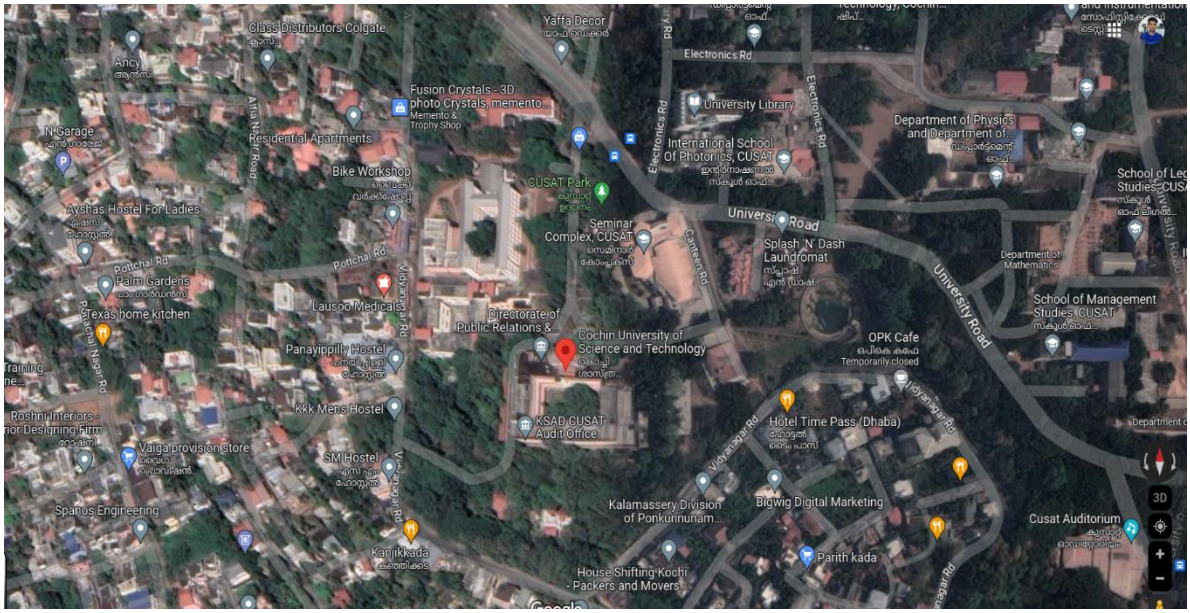


FIGURE 1: CAMPUS LAYOUT

III. GENERAL DETAILS

The general details of the Campus are given below in table.

TABLE 6: GENERAL DETAILS

Sl. No:	Particulars	Details
1	Name of the College	Cochin university of Science & Technology
2	Address	Cochin university of Science & Technology Kalamassery, Ernakulam 682022
3	Web site	Cusat.ac.in
4	Type of Building	Educational Institution
5	Annual Working Days	210
6	No: of Shifts	Day Shift (One) (9:00 AM -5:00 PM)
7	Average power consumption per month. (kWh/month)	266045
8	Average electricity charges per month. (Rs. /month)	2616860

IV. LOAD BALANCE- ELECTRICAL

The details of the loads in the campus at the audit time are given below:

TABLE 7: LOAD BALANCE

Sl No:	Building Name	Connected Load in KW
1	Post Office	3.36
2	Hindi and Foreign language	72.5
3	Basketball court	1.5
4	Thriveni Coffee house	11.024
5	State bank of India	33.19
6	Savana Teachers Hostel Library	37.055
7	Hostel Sanathana	14.05
8	University Guest House	101.355
9	Bachelors Hostel	4.066
10	Gymnasium For men	4.066
11	Play school	4.066
12	Kunjali Marakar School of Engineering	383.25
13	Department of Physics	176.5
14	Substation	0.4
15	Dept. of Applied Chemistry	101.39
16	Dept. of Instrumentation	53.81
17	Dept. of Applied Economics	67.79
18	Dept. of Management Studies	64.13
19	Department of Mathematics	15.5
20	Observatory	7.58
21	Dept. of Statistics	88.5+30kVA
22	School of legal studies	86.06
23	Instrumentation block (Extension)	30.14
24	International Students Hostel	27.6
25	Bio Technology	148.505
26	Ship Technology	77.705
27	Ship Technology	36.38
28	School of environmental studies	203.283
29	Sarovar Hostel	21.355
30	Siberia Hostel	24.6
31	Pump House 1	10

32	Centre for science in Society	47.988
33	Centre for Budget Studies	15
34	Dept. of Polymer science	30
35	Administrative Building	51
36	Engineering Dept.	4.06
Total kW		***2070.26***

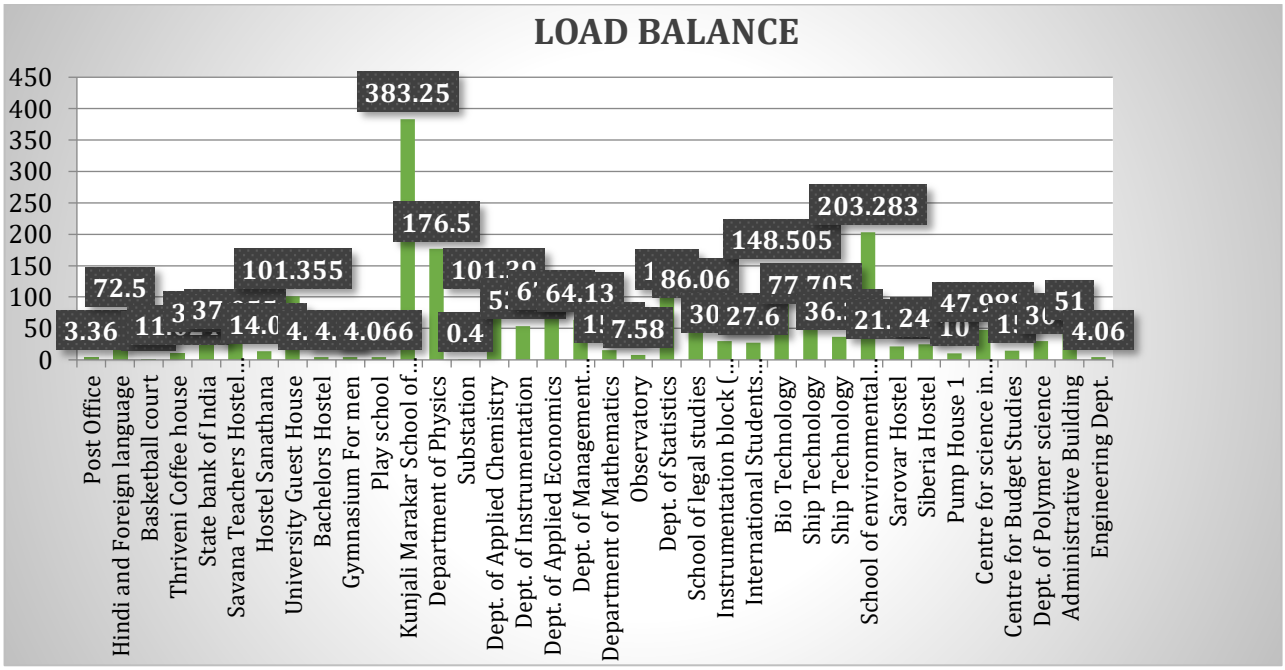


FIGURE 2: LOAD BALANCE – ELECTRICAL

ENERGY & UTILITY DESCRIPTION

In this section the single line diagram of electricity which provides an overview of the energy flow in the building.

I. SINGLE LINE DIAGRAM – ELECTRICAL

The electrical single line diagram of the college is given below:

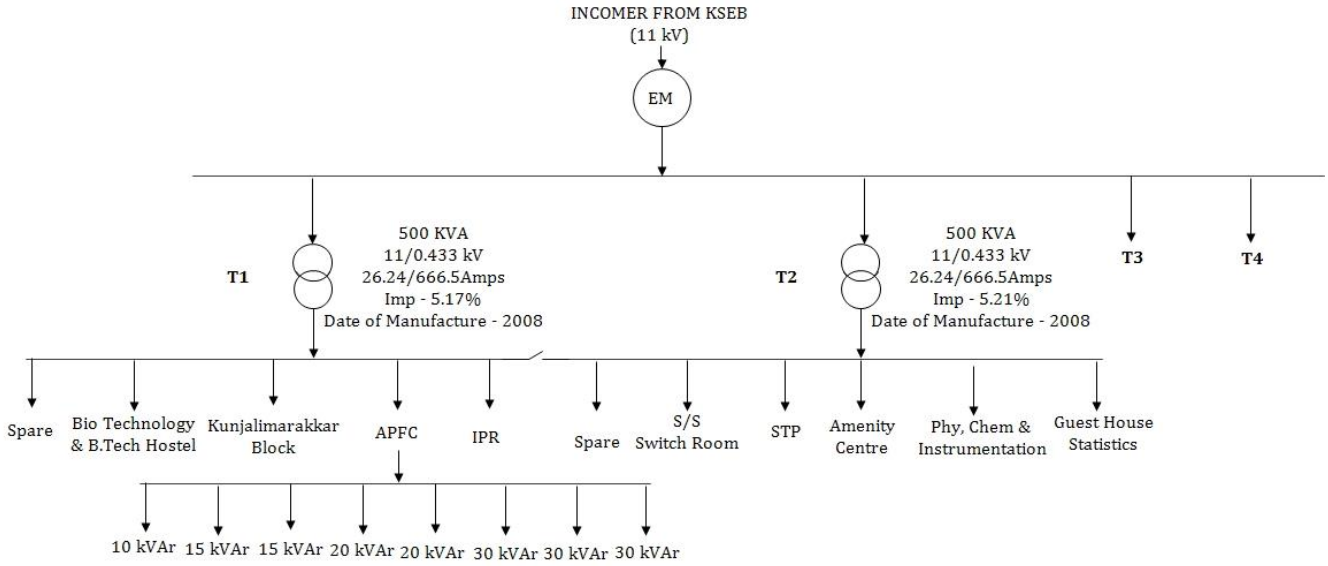


FIGURE 3: SINGLE LINE DIAGRAM – ELECTRICAL

ENERGY ANALYSIS

The different type's energy usage is given in this section. The major source of energy to the college is electricity. Other forms come in the form of diesel.

ELECTRICITY CONSUMPTION ANALYSIS

The major source of electricity to the college is the electrical connection from the KSEBL. Diesel generators are provided in the college, but it is only used during the power failures in critical days like examinations or college events.

I. DESCRIPTION OF ELECTRICITY BILL

Base line data given below is based on the Electricity bill provided by the supplier of electricity to the College. Details obtained from the KSEBL bill for the month of Dec 2021-Nov 2022 is as follows in the Table.

TABLE 8: KSEBL BILL ANALYSIS

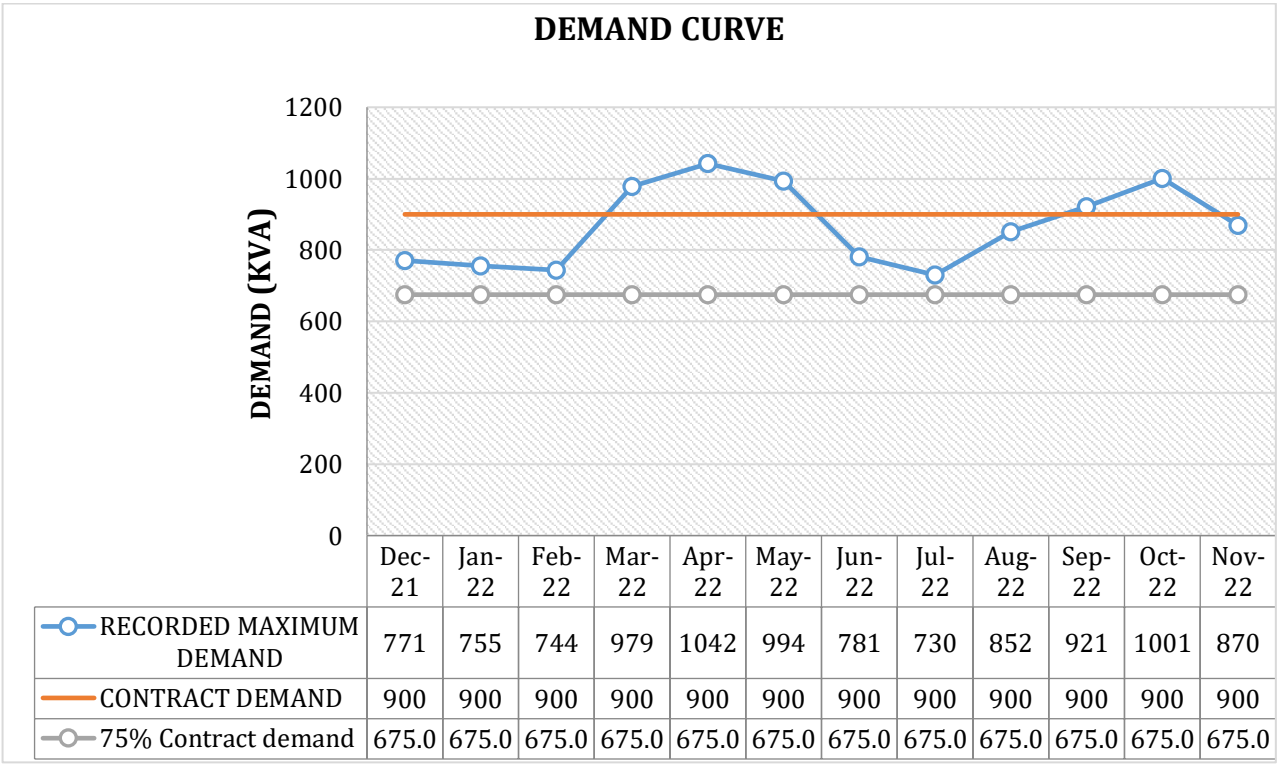
Particulars		Details
Consumer No		1356550000483
Contract Demand (kVA)		900
Connected Load (kW)		2959
Tariff		HT II (B) General
Recorded maximum demand (kVA)		1042 (Apr 22)
Average monthly electricity consumption (kWh/month)		2,66,045
Average Power factor		0.97
Average Demand charges (Rs/month)		4,12,901/-
Annual power factor penalty & Incentive (Rs/year)		Incentive – 2,90,285/-
Demand charge (Rs / kVA)		500
Energy charge (Rs/kWh)	Normal Period	7.8
	Peak Period	11.7
	Off – Peak Period	5.85
Average electricity cost (Rs/month)		26,16,860/-

Inference & Suggestions

- Average Power factor is found to be 0.97. Getting incentives every month for maintaining the power factor.
- For last 12 months, there is only in one month getting the incentive.
- Excess demand charges came 5 months in last year.
- By maintaining the power factor near unity, without leading power factor the college will get incentives for the power factor.
- Recorded maximum demand (RMD) during past 12 month was 1042 kVA. It was recorded during the month of Apr 2022, which is 115.78% of contract demand.
- By analysing the RMD for past year it is clear that by maintain the power factor to unity will reduce the demand charges and the incentive amounts will be more.

II. DEMAND ANALYSIS

This section analyses the trend for the maximum demand versus the Contract Demand (CD) over a 12-month period (Dec 2021-Nov 2022).



	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22
RECORDED MAXIMUM DEMAND	771	755	744	979	1042	994	781	730	852	921	1001	870
CONTRACT DEMAND	900	900	900	900	900	900	900	900	900	900	900	900
75% Contract demand	675.0	675.0	675.0	675.0	675.0	675.0	675.0	675.0	675.0	675.0	675.0	675.0

FIGURE 4: DEMAND IN VARIOUS TIME ZONE

Inference

i. Annual demand charges came as Rs. 49,54,817 /- for the campus.

ii. The recorded maximum demand was found to be 1042 kVA which is 115.78% of the contract demand.

iii. RMD came as more than contract demand in 5 months for last year. Excess demand charges are also coming in that periods.

Suggestion

i. Maintaining the power factor to near unity will reduce the RMD.

III. ELECTRICITY DEMAND IN VARIOUS TIME ZONES

The variations of demands in the time zones are given below in figure.

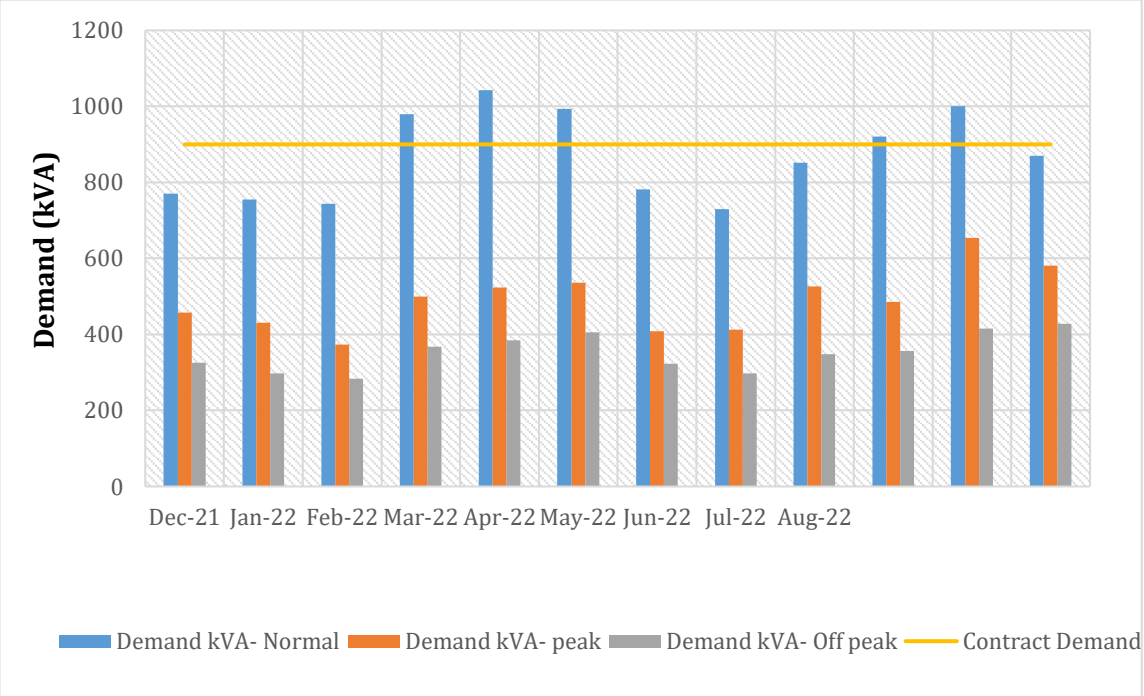


FIGURE 5: ELECTRICITY DEMAND IN VARIOUS TIME ZONE

Inference

i. The average demand registered during the normal, Peak and off-peak period with respect to the contract demand (900 kVA) were 96.67%, 54.53% and 39.19% respectively.

ii. The maximum demand registered during the normal, Peak and off-peak period with respect to the contract demand (900 kVA) were 115.78%, 72.67% and 47.56% respectively.

IV. POWER FACTOR ANALYSIS IN KSEBL BILL

The Power factor is the ratio of Active power (kW) and apparent power (kVA).

$$PF = Active\ energy kWh / Apparent energy\ (kVAh)$$

The power factor variations in past one year is given below in figure.

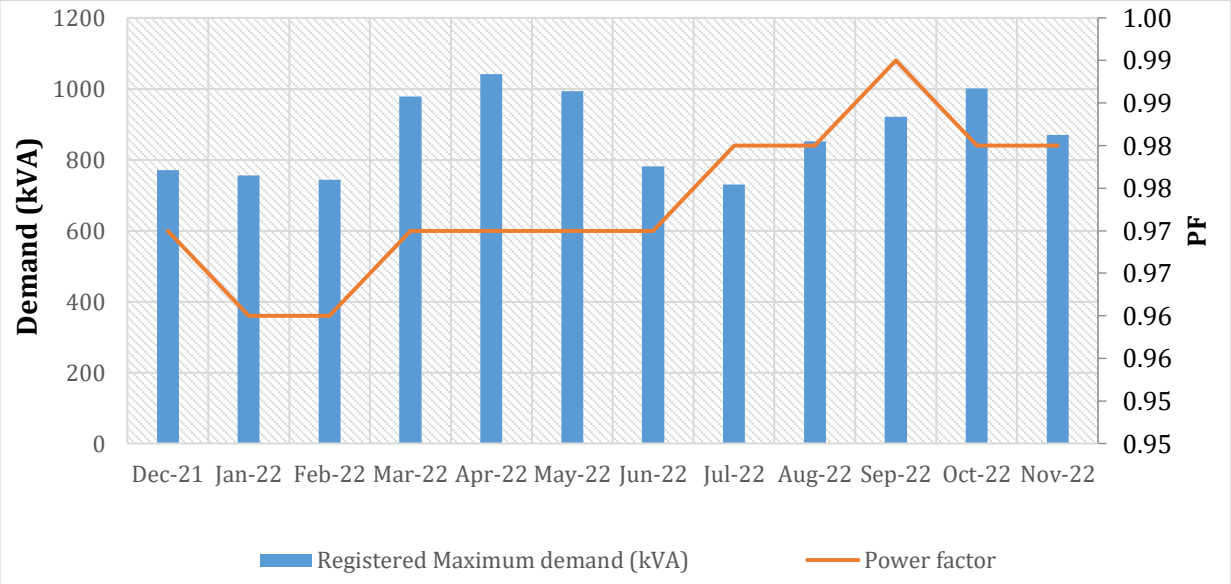


FIGURE 6: POWER FACTOR ANALYSIS

Inference

i. The PF varies from 0.96 to 0.99 during Dec 2021 to Nov 2022.
ii. Average power factor during the past one year is found to be 0.97.

Suggestion

i. Replace the faulty capacitors from the APFC panel.
ii. Provide small divisions of capacitors (1, 2 kVAr) to the MSB for maintain the pf in low load conditions.

V. TARIFF RATES ANALYSIS

The average monthly energy and demand charges for the period Dec 2021-Nov 2022 is represented in Fig.

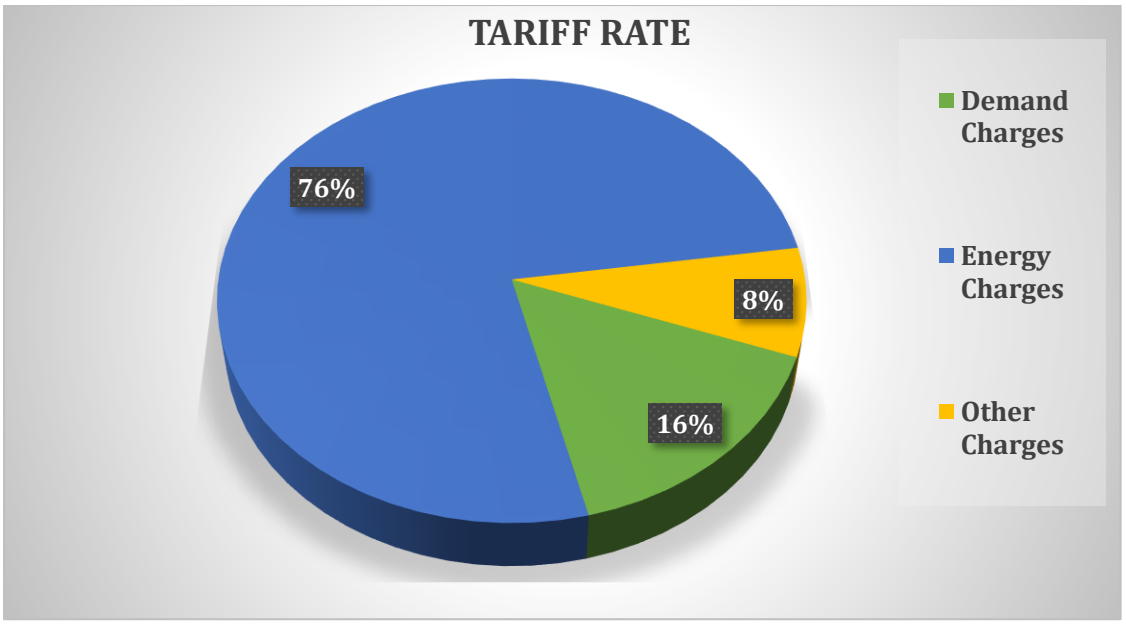


FIGURE 7: TARIFF RATE ANALYSIS

Inference

i. Average demand charges for the past one year were Rs 4,12,901/-per month and energy charges was Rs. 20,19,543/- per month.

ii. The energy charges come about 76% of the total bill for the campus.

UNINTERRUPTIBLE POWER SUPPLY (UPS)

TABLE 9: UPS DETAILS

	UPS		*Battery*			
Location	***Capacity***	***Name***	***Rating***	***Quantity***	***Make***	***Year***
	kVA		***V, Ah***	***Nos***		
Applied Electronics - First Floor	10	Igatech	12, 75	18	Exide	
SMS - Ground Floor	15	Suntroani	12, 150	10	Exide	
SMS - Ground Floor	15		12, 200	10	Exide	
Inverter	2.5	Hykon	12, 150	2	Hykon	
SMS - First Floor	10	Hykon	12, 150	20	Hykon	
DDUK - First Floor	20	Hykon	12, 120	40	Hykon	
Mathematics -Ground Floor	1.5	Keptron	12, 150	2	Supra	
Mathematics -First Floor	1.5	Keptron	12, 150	2	Supra	
Mathematics -Second Floor	10	Supra	12, 26	16	Quanta	
Central Library - New Block	40	Igatech	12, 100	50	Rocket	
Central Library - Old Block	20	Hykon	12,100	30	Rocket	
Chemistry Dept	5	Supra	12,75	16	Exide	2011
Chemistry Dept	5	Supra	12,75	16	Exide	
Insta Lab	20	Supra	12,100	16	Hipower	
Insta Lab	10	Rocket	12,75	20	Hipower	
Near Recreation	2	IWN	12,75	4	Exide	2016
Near Recreation	2	Techsar	12,75	8	Exide	2016
Near Recreation	3	Zenster	12,75	8	Exide	2021
Near Recreation	3	Zenster	12,75	8	Exide	2021
Physics (TFD)	15	Techsar	12,75	20	Rocket	2020
Nuclear Lab (Physics Dept)	6	Delta	12,65	16	Exide	
Dr. Jayasree Room near	2	Hykon	12,65	4	Exide	2017
Dr. Jayasree Room near	6	Delta	12,88	16	Exide	
XRD	5	Techsar	12,40	10	Rocket	
Computer	5	Zenster	12,120	10	Zenster	2018

Nanophotonics	5	Techsar	12,42	10	Exide	2020
Nanophotonics	15	Techsar	12,42	20	Exide	2021
Nanophotonics	5	Techsar	12,42	10	Exide	2020
Nanophotonics	3	Techsar	12,42	8	Exide	2022
Nanophotonics	15	Techsar	12,75	30	Exide	2018
Cosmology	3	Zenster	12,16	6	Zenster	
SBI	5	Numeric	12,150	10	Hipower	2009
SBI	3	Numeric	12,40	6	Exide	2010
Common Facility	1.5	Emerge	12,150	6	Exide	
Biotech (Near Microbial Genetics)	6	APC	12,100	16	Exide	
Biotech (Near Microbial Genetics)	6	APC	12,75	16	Luminous	
SLS - Ground Floor	5	Hykon	12,100	10	Hykon	
Dept of English & SL	1.5		12,150	4	Exide	
Dept of English & SL	5.5		12,150	4		
Dept of English & SL	10	Hykon	12,150	20	Hykon	
Photonics	20	Techsar	12,100	20	Techsar	
Photonics	20	Techsar	12,100	20	Techsar	
Photonics	3	Zenster	12,100	8		
Ship Technology	10		12,75	18	Exide	
Dept of Polymer Science	3	Igatech		4	Amaron	
Dept of Polymer Science	3	Igatech	12,100	4	Amaron	
Dept of Polymer Science	10		12,100	3	Amaron	
Dept of Polymer Science	20		12,100		Powersafe	
Dept of Polymer Science	3					
Admin block	40	Igatech	12,100	42	Hipower	
Second floor	60	Supra		48	Exide	
Marine block						
Lab 108	10	Hykon		20		

Suggestions	i. Proper ventilation should be provided for UPS and batteries. ii. UPS room should be kept neat and clean. iii. Petroleum jelly should be applied to the battery terminals for better life.

ELECTRICITY SUPPLY & DISTRIBUTION PERFORMANCE

The objective of this section is to establish how the facility is performing in terms of energy consumption.

MAIN LOGGING – TRANSFORMER– MEASUREMENT EVALUATION

The main logging of transformers conducted using the Krykard power quality analyser. The Secondary side of the transformers was logged for 24 hours and measured data is given in following table. The measurement-averaging period was 02 minutes.

The summary of measured parameters of the transformer is given in the table below.

TABLE 10: TRANSFORMERS LOGGING

Particulars		**TR 1**	**TR 2**
Rating (kVA)		500	500
Voltage ratings (kV)		11/0.433	11/0.433
Current ratings (A)		26.24/666.5	26.24/666.5
Volt impedance - %		5.17	5.21
Year		2008	2008
Parameters		**TR 1**	**TR 2**
Voltage line (V)	Min	398	399
	Avg	403.49	404.45
	Max	412.1	411.25
Current (A)	Min	119.3	95.26
	Avg	173.49	75.26
	Max	220.3	101.56
Frequency (Hz)	Min	49.83	49.81
	Avg	49.97	49.99
	Max	50.2	50.3
Energy consumed (kWh)	Total	2800	1500
Energy received (kVAh)	Total	2828	1531
Power factor		0.99	0.98
Active power (kW)	Min	108.65	101.55
	Avg	120.97	115.52
	Max	135.31	125.65
Apparent power (kVA)	Min	108.89	102.5
	Avg	121.31	116.5
	Max	135.69	127.56
Reactive power (kVAr)	Min	0.12	1.52
	Avg	4.94	5.66
	Max	10.64	11.65
Voltage imbalance %	Min	0.1	0.2
	Avg	0.25	0.35
	Max	0.4	0.5

Parameters		TR 1	TR 2
Current imbalance %	Min	10.4	11.65
	Avg	17.83	18.95
	Max	30.4	32.56
THDv %	Min	0.8	1.1
	Avg	1.15	1.58
	Max	1.7	2.1
THDa %	Min	3.2	3.6
	Avg	4.55	4.25
	Max	8	8.25

INFERENCE & OBSERVATION – TRANSFORMER EVALUATION

TABLE 11: TRANSFORMER ANALYSIS – INFERENCE & OBSERVATION

<table>
<tr><th colspan="2">TRANSFORMER - ANALYSIS</th></tr>
<tr><th>Inference</th><th>Observation</th></tr>
<tr><td>
The maximum and average loading of each transformer during the period of audit is:
<table>
<tr><th></th><th>Max load %</th><th>Avg load %</th></tr>
<tr><td>TR 1 (500 kVA)</td><td>27.14</td><td>24.26</td></tr>
<tr><td>TR 2 (500 kVA)</td><td>23.30</td><td>25.51</td></tr>
</table>
</td><td>
The present loading pattern of the transformer is not good.
</td></tr>
<tr><td>
The load factor [(Load factor (%) =Energy used during the period (kWh) × 100 ÷ {Maximum demand (kW) × Time under consideration (hr)}] of the transformer during the audit period is:
<table>
<tr><th></th><th>Load factor %</th></tr>
<tr><td>TR 1 (500 kVA)</td><td>68.56</td></tr>
<tr><td>TR 2 (500 kVA)</td><td>65.58</td></tr>
</table>
</td><td>
Load factor of transformer is not good
</td></tr>
<tr><td>
The power factor variations among the transformer are tabulated below;
<table>
<tr><th></th><th>PF – Avg</th></tr>
<tr><td>TR 1 (500 kVA)</td><td>0.99</td></tr>
<tr><td>TR 2 (500 kVA)</td><td>0.98</td></tr>
</table>
</td><td>
The present PF in the college is found to be low at the time of audit and leading occurs.
PF should be improved to unity to receive incentives.
</td></tr>
</table>

HARMONICS ASSESSMENT – AT TRANSFORMER SECONDARY

Harmonics study revolves around the use of non-linear loads that are connected to electric power systems including static power converters, arc discharge devices, saturated magnetic devices and to a lesser degree, rotating machines. Static power converters of electric power are the largest non-linear loads and are used in industry for a variety of purposes such as electro- chemical power supplies, adjustable speed drives, and uninterruptible power supplies. These devices are useful because they can convert ac to dc, dc to dc, dc to ac, and ac to ac. Non-linear loads change the sinusoidal (a succession of waves or curves) nature of the ac power current (and consequently the ac voltage drop) thereby resulting in the flow of harmonic currents in the ac power system that can cause interference with communication circuits and other types of equipment. Classification, effects and standards are given below:

TABLE 12: HARMONICS CLASSIFICATION

	1st order	2nd order	3rd order	3rd order	4th order	5th order	6th order
Frequency Hz	50	100	150	200	250	300	350
Sequence	+	-	0	+	-	0	+

TABLE 13: EFFECTS OF HARMONICS (IEEE 519)

Effect on - Motor & generator	**-Transformers**	**- Cables**	**- Electronic equipment**	**- Metering**
Rotor heating, causes Reverse rotating magnetic field, causes pulsating torque output, Mechanical oscillations, increases Cogging & Crawling	Increase in copper & stray losses, increase in iron losses, transformer heating	Voltage stress & corona, I^2R losses increases	Voltage notching, Electromagnetic interference, Shifting of the voltage zero crossing	Erroneous reading

TABLE 14: CURRENT HARMONICS LIMIT (IEEE 519-2014)

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order (odd harmonics)[a, b]						
I_{SC}/I_L	$3 \le h < 11$	$11 \le h < 17$	$17 \le h < 23$	$23 \le h < 35$	$35 \le h \le 50$	TDD
$< 20^c$	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

[a]Even harmonics are limited to 25% of the odd harmonic limits above.

[b]Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.

[c]All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

where

I_{sc} = maximum short-circuit current at PCC

I_L = maximum demand load current (fundamental frequency component) at the PCC under normal load operating conditions

TABLE 15: VOLTAGE HARMONICS LIMIT (IEEE 519-2014)

Voltage distortion limits		
Bus voltage at PCC	**Individual voltage distortion %**	**Total voltage harmonics distortion %**
V ≤ 01 kV	**5.0**	**8.0**
01 kV < V ≤ 69 kV	3.0	5.0
69.001 kV < V ≤ 161 kV	1.5	2.5
161.001 kV and above	1.0	1.5

HARMONICS MEASUREMENT

1. **Standard for harmonics** - IEEE 519-2014
2. **Normal range of Isc/I_L in the plant** - 20< x ≦ 50
3. **Maximum standard Total demand distortion – current** - 5%
4. **Maximum standard Total harmonic distortion – voltage** - 5%

TABLE 16: TOTAL HARMONIC DISTORTION AT THE TRANSFORMER SECONDARY

Particulars	Rated power	THDv max	THDa max	Remarks	Status with IEEE 519-2014
	kVA	%	%		
Transformer 1	500	1.70	8	THDa is higher than the prescribed limit	High
Transformer 2	500	1.72	8.25	THDa is higher than the prescribed limit	High

Where:

- *THDv – Total harmonic distortion voltage*
- *THDa – Total harmonic distortion current*

INFERENCE & OBSERVATION – HARMONIC ASSESSMENT

TABLE 17: INFERENCE & OBSERVATION – HARMONIC ASSESSMENT

Harmonics	
Observation	**Suggestion**
➢ The present THD current at the secondary side of the transformer is higher than the prescribed limit. <5% shall be the current value). ➢ The voltage THD is found to be within the limits of 5%. ➢ When we analysed, the major cause for the effect of high THD current is the presence of UPS.	➢ To reduce the harmonic effect in the system, the purchase tender of equipment such as UPS, VFD & LED shall contain the Harmonic limitation standard as per the IEEE 519. ➢ This will reduce the effects of non-linear loads in the system.

REACTIVE POWER COMPENSATION - ANALYSIS

APFC panels are installed at the secondary side of the transformer. The rated details and performance of the installed units of capacitors is given below:

TABLE 18: CAPACITOR DETAILS

Name	Rated kVAr	Design Voltage	Measured Voltage	Measured kVAr	kVAr w.r.t to Volts	% of deterioration
	A	B	C	E	F= E*(B/C)2	G= (A-F) *(100/A)
Stage 1	10	440	401.6	7.90	9.48	5.16
Stage 2	15	440	401.6	11.96	14.36	4.29
Stage 3	15	440	401.6	12.01	14.42	3.89
Stage 4	20	440	401.6	10.30	12.36	38.18
Stage 5	20	440	401.6	10.23	12.28	38.60
Stage 6	30	440	401.6	24.85	29.83	0.57
Stage 7	30	440	401.6	20.52	24.63	17.89
Stage 8	30	440	401.6	24.87	29.85	0.49

Inference

1. Some capacitors in the APFC panels are not working well.
2. Power factor can be improved to unity so as to increase the incentives received by the college.

Suggestion

1. Replace/Repair the faulty capacitors in the APFC panel.
2. Provide small rating capacitors to the APFC panel.

BUILDING WISE LOAD & ENERGY - ANALYSIS

At the time of audit, building wise load analysis was taken and logged details are tabulated below:

TABLE 19: BUILINGWISE LOAD ANALYSIS

Sl.No:	*Name*	*Voltage*	*Current*	*Measured Power*			*PF*
		Volts	*Amps*	*kW*	*kVA*	*kVAr*	
1	AMF Admin	428	110.12	71.28	73.68	14.22	0.97
2	Budget Studies	429	18.15	9.40	10.48	2.59	0.89
3	Computer Centre	413	47.6	32.54	33.92	5.15	0.96
4	Electronics GF	432	49.2	27.02	29.8	8.89	0.91
5	Electronics Staircase	433	24.2	12.88	13.35	3.15	0.96
6	MCA	416	22.7	13.05	14.94	6.96	0.87
7	OH Line, Ladies Hostel, Library	417	66.7	48.45	50.54	12.17	0.96
8	Photonics	431	41.8	25.11	25.57	3.41	0.98
9	Pump House, Ship P SRT OH Line	417	71.14	50.21	51.34	1.98	0.98
10	SCS Top floor - Electronics	414	55.7	31.67	33.09	9.07	0.96
11	Biotechnology & B Tech Hostel	405	111.81	77.22	78.41	11.74	0.98
12	Guest House & Statistics	416	104.50	71.69	75.33	21.99	0.95
13	STP	416	9.98	5.61	7.21	4.41	0.76
14	Amenity Centre	416	15.35	9.76	11.03	-4.05	0.88
15	Kunjali Marakkar Block	404	59	38.25	41.35	15.43	0.92
16	Physics, Chemistry, Instrumentation & SLS	415	136.44	97.01	98.12	9.61	0.99

DIESEL GENERATOR

Diesel generator used in the campus as backup supply. There are DG's provided in the facility for different areas. The following table gives the basic details of diesel generator in the facility.

TABLE 20 DG DETAILS

Location	Capacity (kVA)	Make
SMS	150	Kirloskar
SLS	35	Mahindra
Dept. of Eng & SL	45	Kirloskar
Photonics	2.8	

Inference & Suggestions	❖ *The diesel consumption for DG is not recorded properly. A log book to monitor the diesel consumption(L) and unit consumption(kWh) shall be maintained and record it after its running.*

ANNEXURE – 1

ENERGY SAVING PROPOSALS - 1

PF IMPROVEMENT IN ELECTRICAL SYSTEM

Background

By referring the last year bills, it is clear that the average power factor was varying from 0.97 to 0. 99.. Last 12 months here getting the incentives for power factor.

Proposal

Replace/Repairing the existing capacitors in APFC panels with a new one and also providing small rating capacitors from the MSB to improve the PF to unity and gain incentives. For improving the power factor to unity then the demand charges also will reduce. The calculations regarding the present scenario is tabulated below:

Present Condition - Contract Demand is 900 kVA and PF is 0.97					
Month	***RMD***	***BD***	***PF***	***Demand Charges***	***Incentives***
	KVA	***KVA***	***Rs***	***Rs***	***Rs***
Dec-21	771	675	0.97	339240	17955
Jan-22	755	675	0.96	332200	8349
Feb-22	744	675	0.96	327360	7765
Mar-22	979	675	0.97	448140	22391
Apr-22	1042	675	0.97	489720	22101
May-22	994	675	0.97	458040	21188
Jun-22	781	675	0.97	342617	18579
Jul-22	730	675	0.98	365000	28711
Aug-22	852	675	0.98	426000	30554
Sep-22	921	675	0.99	465750	40411
Oct-22	1001	675	0.98	525750	35935
Nov-22	870	675	0.98	435000	36345
SUM				***4954817***	***290285***

Proposed Condition - Contract Demand is 225 kVA and PF is 1							
Month	***RMD***	***BD***	***Demand Charges***	***Savings in Demand Charges***	***Incentives***	***Savings in Incentives***	***Total Savings***
	KVA		***Rs***	***Rs***	***Rs***	***Rs***	***Rs***
Dec-21	748	675	3,29,063	10,177	**44,887**	**26,932**	**37,109**
Jan-22	725	675	3,18,912	13,288	**41,744**	**33,395**	**46,683**
Feb-22	714	675	3,14,266	13,094	**38,826**	**31,060**	**44,155**
Mar-22	950	675	4,28,837	19,303	**55,978**	**33,587**	**52,890**
Apr-22	1011	675	4,69,146	20,574	**55,252**	**33,151**	**53,726**
May-22	964	675	4,24,239	33,801	**52,970**	**31,782**	**65,583**
Jun-22	758	675	3,33,331	9,286	**46,448**	**27,869**	**37,155**
Jul-22	715	675	3,57,700	7,300	**47,852**	**19,141**	**26,441**
Aug-22	835	675	4,17,480	8,520	**50,923**	**20,369**	**28,889**
Sep-22	912	675	4,58,895	6,855	**50,514**	**10,103**	**16,958**
Oct-22	981	675	5,10,740	15,010	**59,892**	**23,957**	**38,967**
Nov-22	853	675	4,26,300	8,700	**60,577**	**24,232**	**32,932**
SUM				***47,88,908***	***1,65,909***	***6,05,863***	***3,15,578***

Summary of the Proposal

TABLE 21: EC PROPOSAL 1

Annual Incentive Increment	***Rs***	***3,15,578***
Annual Demand Charges Savings	***Rs***	***1,65,909***
Total Savings	***Rs***	***4,81,487***
Investment	***Rs***	***1,00,000***
Simple Payback Period	***Months***	***02***

ENERGY SAVING PROPOSALS - 2

REPLACEMENT OF FLOURESCENT LIGHT FITTINGS WITH LED LIGHTS

The present light fittings are mainly being the fluorescent light of different ratings. By replacing these light fittings with LED, the consumption of electricity will reduce considerably.

Particulars	Units	T12	T8	T5
Power of Fluorescent lights	Watts	40	36	28
Power of proposed LED tube	Watts	20	20	20
Difference in Wattage	Watts	20	16	8
Avg No: of working hours/day	Hrs	8	8	8
No: of working days per year (Average)	Nos	210	210	210
No: of working hours per annum	Hrs	1680	1680	1680
Number of Lights operating	Nos	100	300	80
kWh Saving per Annum	**Rs**	**3360**	**8064**	**1075.2**
Cost per kWh (Average)	Rs	8.45	8.45	8.45
Annual Financial Savings	**Rs**	**28392**	**68140.8**	**9085.44**
Cost of LED tube	Rs	300	300	300
Investment for LED lights	**Rs**	**30000**	**90000**	**24000**
Simple Payback period	**Months**	**13**	**16**	**32**

Summary of the proposal

Table 22: EC PROPOSAL 2

Annual Unit Savings	**kWh**	**12,499**
Total Savings	**Rs**	**1,05,618**
Total Investment	**Rs**	**1,44,000**
Payback Period	**months**	**16**

ENERGY SAVING PROPOSALS - 3

REPLACEMENT OF LOW STAR RATED AC'S WITH 5 STAR RATED AC'S

Background

Here 1 TR, 1.5 TR and 2T low star rated ACs are provided in the labs and classrooms and office working 8 hours daily above 4 Years consumes higher power.

Proposal

Replace the AC with 5 star rated one will provide sufficient energy savings. The calculations are given below:

1. CAPACITY OF AIR CONDITIONER -1 TR

Particulars	**Location**	Department of Physics	Department of Physics	Department of Chemistry	Interuniversity	Department of Statistics
	Area	TFD	Magnetics	Instr. Room 1	Faculty post doc	Computer Lab
Present power consumption of AC	Watts	1040	1028	1230	1076	1094
Capacity of proposed 5 Star Inverter AC	TR	1	1	1	1	1
Power of proposed 5 Star Inverter AC	Watts	920	920	920	920	920
Difference in Wattage	Watts	120	108	310	156	174
Avg No: of working hours/day	Hrs	8	8	8	8	8
No: of working days per year	Nos	210	210	210	210	210
No: of working hours per annum	Hrs	1680	1680	1680	1680	1680
Total no:of AC's operating	Nos	1	1	1	1	2
Annual power consumption of old airconditioners	kWh	1747.2	1727.04	2066.4	1807.68	3675.84
No: of working houres of new AC	Hrs	4	4	4	4	4
Annual working houres of new AC	Hrs	840	840	840	840	840
Annual energy consumption of new AC	kWh	772.8	772.8	772.8	772.8	1545.6
kWh Saving per Annum	kWh	974	954	1,294	1,035	2,130
Cost per kWH (Average)	Rs	8.45	8.45	8.45	8.45	8.45
Annual Financial Savings	Rs	8,234	8,063	10,931	8,745	18,001
Investment for AC	Rs	32,000	38000	38000	38000	38000
Total Investment	Rs	32,000	38,000	38,000	38,000	76,000
Simple Payback period	Months	47	57	42	52	51

SUMMARY		
Annual unit savings	kWh	6387
Total savings	Rs	53973
Total investment	Rs	222000
Payback period	months	49

2. CAPACITY OF AIR CONDITIONER -1.5 TR

Particulars		Department of Physics				Department of Chemistry	Department of Biotechnology	SMS	Central Library	Old Building	SLS	Department of English & FL		Photonics	Ship Technology	SBI	Interuniversity
		Laboratary	Office	Nanophotonics		Instr. Lab 2	Nanobiotech	Hall of Frame	E Journals	Audio visual & research centre	Seminar Hall	Faculty room	Lab	Computer Lab	HOD	Bank Hall	Classroom ,Chara. Lab 2
Present power consumption of AC	Watts	2300	1129	1842	1122	1362	1940	1728	1432	1586	1860	1428	1458	1882	1654	1544	1355
Capacity of proposed 5 Star Inverter AC	TR	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Power of proposed 5 Star Inverter AC	Watts	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
Difference in Wattage	Watts	1200	29	742	22	262	840	628	332	486	760	328	358	782	554	444	255
Avg No: of working hours/day	Hrs	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
No: of working	Nos	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210

days per year																
No: of working hours per annum	Hrs	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680
Total no:of AC's operating	Nos	2	2	2	1	1	1	4	3	4	1	1	1	1	1	3
Annual power consumption of old AC	kWh	7728	3793.44	6189.12	1885	2288.16	3259.2	11612.16	7217.28	10657.92	3124.8	2399.04	2449.44	3161.76	2778.72	2593.92	6829.2
Working houres per day of new AC	Hrs	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Annual power consumption of new AC	kWh	1848	1848	1848	924	924	924	3696	2772	3696	924	924	924	924	924	924	2772
kWh Saving per Annum	kWh	5,880	1,945	4,341	961	1,364	2,335	7,916	4,445	6,962	2,201	1,475	1,525	2,238	1,855	1,670	4,057
Cost per kWH (Average)	Rs	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45	8.45
Annual Financial Savings	Rs	49,686	16,439	36,682	8,120	11,527	19,732	66,892	37,563	58,828	18,597	12,464	12,890	18,909	15,672	14,111	34,283

Investment for AC	Rs	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Total Investment	Rs	80,000	80,000	80,000	40,000	40,000	40,000	1,60,000	1,20,000	1,60,000	40,000	40,000	40,000	40,000	40,000	40,000	1,20,000
Simple Payback period	Months	19	58	26	59	42	24	29	38	33	26	39	37	25	31	34	42

Summary		
Annual unit savings	kWh	51,171
Total savings	Rs	4,32,396
Total investment	Rs	11,60,000
Payback period	months	32

3. CAPACITY OF AIR CONDITIONER – 2 TR

Particulars		Library	Microbiology, Microbial	Library
Present power consumption of AC	Watts	2392	2218	2113
Capacity of proposed 5 Star Inverter AC	TR	2	2	2
Power of proposed 5 Star Inverter AC	Watts	1487	1487	1487
Difference in Wattage	Watts	905	731	626
Avg No: of working hours/day	Hrs	8	8	8
No: of working days per year	Nos	210	210	210
No: of working hours per annum	Hrs	1680	1680	1680
Total no:of AC's operating	Nos	1	3	4
Annual power consumption of old Acs	kWh	4018.56	11178.72	14199.36
Working houres per day of new Acs	Hrs	4	4	4
Annual energy consumption of New Acs	kWh	1249.08	3747.24	4996.32
kWh Saving per Annum	kWh	2,769	7,431	9,203
Cost per kWH (Average)	Rs	8.45	8.45	8.45
Annual Financial Savings	Rs	23,402	62,796	77,766
Investment for AC	Rs	50,000	50,000	50,000
Total Investment	Rs	50,000	1,50,000	2,00,000
Simple Payback period	Months	26	29	31

SUMMARY		
Annual unit savings	kWh	19,404
Total savings	Rs	1,63,964
Total investment	Rs	4,00,000
Payback period	months	29

TABLE 23: EC PROPOSAL 3

Particulars	Unit	Values		
Capacity of proposed 5 Star Inverter AC	TR	1	1.5	2
Total no:of AC's operating	Nos	6	29	8
Annual unit savings	kWh	6387	51,187	19,404
Net annual savings	Rs	53,973	4,32,396	1,63,964
Net annual investment for AC	Rs	2,28,000	11,60,000	4,00,000
Annual unit savings	kWh	76,978		
Total savings	Rs	6,50,333		
Total investment	Rs	17,88,000		
Payback period	months	33		

ENERGY SAVING PROPOSALS - 4

REPLACEMENT OF CEILING FANS IN THE OFFICE WITH ENERGY EFFICIENT BLDC FANS

BACKGROUND

A BLDC fan takes in AC voltage and internally converts it into DC using SMPS. The main difference between BLDC and ordinary DC fans is the commutation method. A commutation is basically the technique of changing the direction of current in the motor for the rotational movement. In a BLDC motor, as there are no brushes, so the commutation is done by the driving algorithm in the Electronics. The main advantage is that over a period, due to mechanical contact in a brushed motor the commutators can undergo wear and tear, this thing is eliminated in BLDC Motor making the motor more rugged for long-term use. To explain, BLDC technology in simpler terms, BLDC uses a combination of Permanent Magnets and Electronics to achieve the kind of efficiency and performance, it delivers. A BLDC fan composes of 3 main components: - 1. Stator 2. Rotor 3. Electronics

PROPOSAL

Replace the ceiling fans with BLDC in the as per preference of operating hours as office areas, staff rooms, hostel and in class rooms, the calculation for the savings is given in the table.

Particulars	Units	College	Hostels
Power of existing ceiling fans at full speed	Watts	60	60
Power of BLDC fans at full speed	Watts	28	28
Difference in Wattage	Watts	32	32
Avg No: of working hours/day	Hrs.	8	10
No: of working days per year (Average)	Days	210	210
Number of Ceiling Fans operating	Nos	200	150
kWh Saving per Annum	**kWh/annum**	**10,752**	**10,080**
Cost per kWh (Average)	Rs/kWh	8.45	8.45
Annual Financial Savings	**Rs/annum**	**90,854**	**85,176**
Cost of BLDC Fans	Rs/no	3,500	3,500
Investment for BLDC Fans	**Rs**	**7,00,000**	**5,25,000**
Simple Payback period	**Months**	**92**	**74**

Summary of the proposal

TABLE 24: EC PROPOSAL 4

Annual Unit Savings	**kWh/annum**	**20,832**
Total Savings	**Rs/annum**	**176,030**
Total Investment	**Rs**	**1,225,000**
Payback Period	**Months**	**84**

ANNEXURE-2

CONNECTED LOAD

I. LIGHT & FAN LOAD

Location	*LED Tube*									*LED Tube*	*LED Square*	*LED*	*T5*	*T8*	*T12*	*T5 (2 Ft)*	*CFL*					*BLDC*	*Ceiling Fan*		*Table fan*	*Pedes. Fan*	*Ex. Fan*		*Wall Fan*
Watts	*18*	*4*	*5*	*6*	*8*	*9*	*12*	*18*	*150*	*36*	*40*	*500*	*28*	*36*	*40*	*14*	*10*	*11*	*18*	*24*	*45*	*30*	*60*	*100*	*60*	*60*	*50*	*120*	*60*
Dept. of Applied Electronics																													
Corridor	2																												
Ground Floor																													
Corridor	5																												
Library	17												1	19	7							3	21						2
Toilets						8								2															
SMS Library	37									4			6	21									6			4			4
Research Scholar	1														1								2						
Computer Lab	5												1										3						4
Seminar Hall	1	8												11															9
First Floor																													
Corridor	3													1															
HOD Room	1													1									2						
Room 13													1		2								3						
Corridor	6																												
Office (3 Rooms)	8														1								6			1			
Toilets	2					6																							
Classroom (9)	4												2										4						

Project Fraction						6																							6
Ladies comfort room		4																											2
DDUK Secretariat						11																							7
Skill Lab	12																												8
Corridor	2																												
Second Floor																													
Corridor	8																												
Analytical Lab	26																												12
Shill Lab	12																												8
Room Director	12																										1			2
Toilets	1	3																											
Third Floor																													
UPS Room	2																										2		
SMS																													
Ground Floor																													
Toilets		2																											
Corridor	2													3	1								1						
Office	5													3									1	6		1			
Computer Lab														18												1			
Hall of Frame		4				8																							
Auditorium	45											3											20			3			3
First Floor																													
Corridor	7													3									1						
Faculty wing														1				1					1						

Classrooms (12 Rooms)	8					12								4									12						
Faculty room	2													7									5			1			
Classrooms (S5, S4)						11																	7						
S2	2													7									5			1			
Toilets		4																											
Director room	11					3								1									6	1		1			
Second Floor																													
Corridor	3					2								3	1														
Classrooms (1, 2)	8																						6						
Classrooms (3)	12																						12						
Room T5						36																	24						
Course work T4	2																						2	1					
Room T3						10																	7						
Room T2						11																	6						
Room T1						6									1								5						
Toilets		4																									2		
Mathematics																													
Ground Floor																													
Corridor	8													2									1						
Research room 1	1												1		2								1	1					
Toilets	2																												
Faculty room	5																						5						
Common room	1													3										1		1			
Library	7													8	2								3	3					
Ladies waiting room	1														2			1					1	1					

First Floor																													
Lecture room (106,107)															10								2	4					8
Corridor	7																												
Research room															4								1	1					
Room 109 (Faculty)	1																						1						
HOD room (104)						1									4									2					
Toilets	1																												
Faculty room	4																						2						
Office																													
Second Floor																													
Corridor	14																						1						
Auditorium													3	5									10						
Research room 1,2	3													4									4						1
Computer Lab															4								2						
Faculty room														8									4						
Room 204														6									2	2					
Central Library - New Building																													
Ground Floor																													
Corridor	8																												
Office	1					18															1		7			1	1		2
Reception						9							4					2											3
Students Lounge	1					23														1									10
Toilets	2					4																					2		

First Floor																													
Corridor	4					6							8										5						1
Reference 1	4					17																							6
Reference 2	18									4			12							1			8						4
Toilets	2					4																				2			
Second Floor																													
Corridor	2									1			10										2						
E Journals	2					6							4			12							11						5
Periodicals	30																						10						7
Toilets	2					4																				2			
Central Library - Old Building																													
Ground Floor																													
Corridor	4													3															
Toilets	1													1				1		1						1			
UPS room	2													4									2						
GO2	6													1									2			1			
Store room (GO1)														8									3						
GO6	4													6									2			1			
GO3	1													2									1						
GO4	1													2									1						
GO5	3													6									2			1			
Dining hall	4																						2						
ETD Lab														4									2						1
GO 8	1													1				1					1			1			
First Floor																													
Fiction														68									11						5
OPAC	4													4															4
Stack 1	13													15															4

104	2													7									2						
201														68									12						
Third Floor																													
Corridor														39															1
Photocopy room														2									1						
Fourth Floor																													
Corridor						1								8															
Rooms														20									10						
Toilets						3												2											
Dept. of Chemistry																													
Common area & Toilets	53	1												19									12				2		
Classrooms	40													3									24			1	1		4
Office rooms	36													32						40			24			6			
Labs	37	22												40	3			1					47				14		
Dept. of Physics																													
Common area & Toilets	88													9	1								16			1			2
Classrooms	18																						13						
Office rooms	100																						48			5			3
Labs	139	1												9	3			7									11		1
Dept. of Biotechnology																													
Common area & Toilets	30														3								5				2		
Classrooms	30																						15						
Office rooms	9													1									5						2
Labs	92	10												1									49			1	3		3
Dept. of Instrumentation																													

Common area & Toilets	79													19									29						
Classrooms	42																						42						
Office rooms	21																						12				2		
Labs		34																					16				2		
Dept. of Hindi																													
Common area & Toilets	11	2												2	1														
Classrooms	30	1												6	7								17						10
Office rooms	24	1												22	22								30			2			17
Library						124																							20
Post Office																													
	5												1										2						1
State Bank of India																													
	11					3					21												7				3		8
Common Facility																													
						1								10	1								19						
Dept of Statistics																													
First Block																													
Ground Floor																													
Seminar Hall														16															
Common Area	10																						4				4		
Library	8													8									3			1			4
Faculty Room	1																						1						
Room	1																						1						
Office	3																						4						
Faculty Room	3																						2						
Research Room	2																						4						

Faculty Room	1																						1						
Faculty Room														2									1			1			
Research Room														3	3								4						
Faculty Rooms (3 Nos)														6									3			3			
Research Room														3	1								4			1			
First Floor																													
Common Area	8																												
Computer Lab						15																							
Toilets																													
Classrooms	9																						12						
Faculty Room	3																						3						
Studio	1																						1						
SLS																													
Ground Floor																													
Office	9																						6						
Common Area	6													4															
Seminar Hall	30																									8			
Toilets						3																					2		
Mini Hall																							2			1			
Director Room														8										2			1		
Library	46										1			9										10					7
Room														1	1														
Dept. of Eng. and SL																													
Ground Floor																													
Room	2																						2						

Class	2																						2						
Office	3																						3						
Common Area	8																												
Faculty Room	2																						2						
Faculty Room	4																						2						
Class	3																						4						
Class	10																						8						
Library	5																						4			1			
Lab	12																												
First Floor																													
Common Area	7												1	3															
Class													1	1										1					
Faculty Room	2																						1						
Room	2																							1					
Sick	1																				1								
Faculty Room (6 Nos)	12																						6						
Toilets		9																									3		
Class	4												4										8						
Second Floor																													
Common Area	3												13																
Class	4											1	2	2									8						
Class	1												9	2									8						
Class	1												3	1									2						
Toilets														2													1		
Class	4												8										6						
Class														2									1	1					
Faculty Room													1										1						
Court Hall	4												3	3										6		3			4

Research	6													4	1								11						
Basement	1	1												2												3			
IPR Studies																													
Ground Floor																													
Office	4																						2						1
Toilets	1	2																								1			
Common Area													8					16											
Conference Hall	36																									1			
Dining	2												16							1			4				1	2	
Common Area						1																							
Faculty Room	1												4										2						
Visiting	3																						2						
Toilets						1																				1			
Faculty Rooms (3 nos)	3												6										3						
Faculty Room	1												2										2			1			
Toilets	2	1				1														1						4			
Director						1							4										2				1		
Toilets	1	1																1											
Room													4										1						
Class	2																						1						
Class	2																						1						
Class	2																						1						
First Floor																													
Faculty Room	2																						1						
Class	2																						1						
Class	4																						2						
Toilets	1																									1			
Recreation	5																						3						

Common Area						4																							
Second Floor																													
Common Area						1							1							4			2						
Library	2												68										27			1			
Room						8																	1			1			
Room	1					8																	1						
Room						8																	1						
Room										1																			
Class	4																						2						
Room													2										1						
Toilets	1					32																				2			
Class						32																							
Room	2												8										6			1			
Room						2																	1						
Toilets	15					1											6												
Seminar Hall	8																						6						
Rooms (9 nos)	21																						9						
Photonics																													
Ground Floor																													
Office	5													2									7			1			
Class														5	4								6						
Director Room	3																												
Lab	32																						2						3
Common Area	22																												
Committee	1									3																1			
Room														1															
Electrical														2															
Toilets														3													1		
Room														1	1														

Class														8	3								2						
Seminar						4				3				2				5		2									
Lab														9									3						2
Lab														4	4								1			1			
Lab	32																						2						3
Lab	10													12															
Library														8	6								7				2		
Room	2													2									5						
Lab	4													11	1								3			1			
Common Area						5								6									1						
Faculty room										3													2						
Computer Lab														12										5					
First Floor																													
Common Area										1				1									1						
Faculty room										12													6						
Toilets		2																									2		
Electronics Lab														16									6			1			
Room										20																			
Lab										9											2					1			
Hall														36				12					12						
Toilets	4													4															
Class														16									6						
Class														14									6						
Faculty room	2																						1						
Faculty room						5																					1		
Room						4																	1						
Room														2									1						
Ship Technology																													
Ground Floor																													

Common Area	3													7															
Seminar Hall	6													1	3							1	3						2
Library														5	5								6						
Store office														2									1						
First Floor																													
2B	6																						6						
Toilets														2															
212 B	1													3	1							2	1						
Model Room	4																							1					1
211														5	1							2	1						
210														5	1							2	1						
209A	8					12																2	1						
Common Area	2													2															
Second Floor																													
307	2													1	1								2						
308	2																						1						
310														2									1						
Common Area	2																												
311	2																						1						
313B														5	1														
306															2								2						
Room	2																						2						
Toilets														2															
Common Area															1														
314A	1													1	8							5	1						
315B	2													4	2							1	4						4
Ground Floor																													
Office	12																						3						1
HOD	4													8									3			1			

Dept Rooms	8													8									4						
Restroom	1																						1						
Ship Technology Lab Block																													
L-01	2													4	2								4						
L-02	6													6									3						
L-03														10	2								3						1
L-04	6													12									5				1		2
L-05	12													4	1							1	3						
L-07	6													21	1								13				1		
Dept. of Polymer Science																													
Ground Floor																													
Common Area														8															
Office	1													5									5						
Lab	3																						2						
Lab 2	3													1									2				1		
113	1																						1						
Lab 3 - 109	2													1	2								2						
Library	3													3	2								6						
Professor room	8																						4						
108	2														2								2						
104														4									4						
103														4									4						
Thermostat Lab	3													2	6												2		2
Common Area	4													1									2						2
RT Auditorium	4													9									17						
First Floor																													
126														4	1								4						
121														3									4						

Common Area	1													4															
127														2									2						
128	2													5	1								3				1		
120														4									2				2		
Toilets	2																												
Dept. rooms	2																												
125														4									2						
122	4													1	1								1						
124	5																						1			1			
Lab	3					2								6	4								4				2		
B4														2									133						
140	3					7																							6
136	1													2									2						2
138														6									2				1		
139														11									2				1		
140	2																												1
Corridor														6															
141														4									2				2		
Centre of Budget Studies																													
Office	8																						2						
G02						1				6													2						
G03										6													2						
G04										6													2						
G05										6													2						
G06	2																						1						
G07	2																						1						
G08														8									8						2
G09										5													6						
G10						12																	6						
Centre for Integrated																													
2										8													2						
4	6																						2						
3	6																						6						
1	4																						2						

8						15																	10						
9	28																						9						
11						6																	5						
Corridor	22																												
Toilets	2																												
Second Floor																													
12	6																						2						
14	6																						2						
15	5																						2						
16	3																						1						
17	5																						2						
18	2																						2						
19	1																						2						
20	9																						6						
23	4																						1						
21	6																						4						
22	6																						4						
Common Light	20																												
27	3					16																					1		
26	32																												8
Admin block																													
Room	2													1	1										1				
Common						15								16															
PRO							6	1																					4
General Admin														5									5						
Dept of Registration	2																						2						
Meeting room														8									4						
Room 5	36																						6	12					21
Legal Office	2																						2						
Room 7														8									4						

Recruitment cell	2																						4						1
Administration B&G	7													3									6			2			3
Toilet	2																												
Office of KSAD	12													3									7						
Joint direct	1													2									2						
Admin A,D,F&E	11																						8			4			5
Fair copy & despates section	12																						6			1			
General services	10																						4			1			1
Vehicle	2																						3			4			
Records	8													8	11								5	2		1			
Audit E,NSP,Payroll	7																						6	1		6			
Rest room	2																						1						
Pay roll (A) section	9																						1						
Finance & 1A,1B	7													2												2			3
Dept. of Registration															1								1						
Audit A,B,C,D section	20					3																		13					10
Finance Office	11																						4			1			
Cash section	4																						4						4
Section Office	2																						1						

First floor																													
Common	37																					4	3						
UGC Cell	8																						7	3		3			
Tech Foundation	12																						3						
Exam confidential section	18																						1			4			
Province Chancellor	32																						5			3			
e-Governance cell	7																						3			1			
Academic section, Joint registration	10																					1	8			2			
Toilet	4																						1						
Senate hall					16																		8	1					
DOA Confidential row	12																						4			2			
Co Welfare foundation	2																						3			1			
Director	4																						1						
Directorate of Admin	6																						4			4			
Fair copy 2&3	6																						4						1
Conference section	8																						4			1			
Syndicate hall														24					7				1			7			

Planning A	7																						6			2			
Planning B	6																						4						
Planning & Development Office	2													1									1			1			
VC	22																						6			1			
UC room	16																									2			
V/C conference room	4																27						1			7			1
V/C room														12												3			
Second floor																													
Room	6														1														2
CU-Camp hall C	3													3									2						
CU-Camp hall A	18																						11						2
Toilet	2																												
Exam NIRP section	12																						10			4			
Exam H section	18																						6						
Common	11																		32										
Toilet	4																						1						
ARIS lab	7													3	6								8						
International rec	19																												4
Examination C section	4													4	16								9			2			
Exam F section	16														8								14			6			
IQAC			28																			4				1			4

Deputy registration	5																						6	3		4			
Exam B,D section	20																						9			2			
Exam A,E section	25																						9			4			
Exam section	18																						6			2			
Exam B section	18																						6			3			
Controller of examination	20													2									9						1
Exam T section	12																									5			4
Pool Office	8																						4			5			
Marine block																													
V room														4									1						
C room	20																						6						
Director Office														16									7						
Common														12															
Faculty cabins	6													36									18						
Rest room	1																						1						
Toilet	4													4									4						
Course in chore																													
Stationary room	8																						3						
Office	4													8									6						1
Library	48																						18						
Professor														6									3						
A Professor	6																						3						

G 65	7													1									3						
First floor																													
Room	9													4									2						
101	4													20									9						
Class 103	6													7									9						
Class 102	4																												
Control Ems lab	2													24									9						
Simulation lab														24									9						
114														4									1						
Class 113	9													24									9						
Lab 108														24															
Class 112	6													24									9						
Class 111														24									9						
Toilet	4													4									4						
Second floor																													
Class 210														16									6						
Toilet	4													4									4						
Lab 211														32									12						
e-lab														16									6						
FFA & CSA lab														24									9						
Computer lab 206														8									3						
212														24									9						
213														4															
Class 205														51									18						
Class 201														24									9						
Working area						2																	1						

Common	10													13															
Seminar hall														48									18						
Workshop	1								36					74									2						14
Marine Workshop 1	2													94									12						20
Marine Workshop 2	2													94									12						20
Common	8																												
Ship																													
Engine room	63													22	3								1						2
Engineering Department																													
Ground Floor																													
Corridor	1				7				3							1													
Panel room																1													
Office accounts	2															1					1								
Office admin	2															1					1								
Asst. Register	1								1							1													
Office admin	2															1					1								
University Engineer									2							1													
Office records	1								1							1													
Technical officer	1								1							1													
DB Civil	1								1							1					1								
Asst Engineer 1	2															1		1											
Asst Ex.Engineer 1	2															1					1								

Engg dept. room	1								2							2														
First Floor																														
Corridor			2						3							1														
Plumbing Supervisor	1															1														
Plumber room																1														
Store									1							1														
Asst Engineer IV	1								1							1					1									
Electrical staff	1								1							1														
Asst Exe. Engineer IV	1								1							1														
Asst Exe. Engineer Electrical	1								1							1														
Asst Engineer VI	2															1		1												
Staff room	1								1							1					1									
Engineer room	2															1		1												
AE 3	1									1						1		1												
AE 3	2															1					1									
Store									1							1														
Seminar Complex																														
Ground Floor																														
Room 1									1							1														
Room 2									1							1														
Room 3									1							1														
Room 4									1							1														

Corridor	3								3	3						1														
Toilet		3																												
Electrical DB room									2							1														
Auditorium		4	57		1				1																					
Entrance area			4		3				15	7		30						1												
Toilets	1	3																	2											
Toilets	1	3																	2											
Outside												12																		
Store									1							1														
First Floor																														
Corridor	1				3				8	12						1														
Executive Hall	10	5																												
Room 5									2							1														
Office	1									2						1														
Toilets		4								4									4											
Committee Hall					10																									
AC room									2																					
Outside						4																								
Canteen																														
Whole area - Canteen	40															8														
School of Environmental Studies																														
Ground Floor																														
Corridor	8								6																					
Dean & former director	3															2														
Dr Anand	1								2							2														

madhavan																														
Toilet	1									1																				
Dr Ratheeshkumar	2									1						2														
Conference room									6	6						8														
Dr Suja P devipriya	1															2		1												
Dr Preethychandran	1															2		1												
Dr Usha K anand	1															2		1												
Bet Analaysis			4																											
Dr Vrinda	1															2		1												
Common room									3							3														
Computer room					4								10																	
Library	8															5														
Director	12															4														
AAC Lab	5																													
Office	6															4			2											
Office	2								3							3														
Classroom (3 nos)	6															4														
Toilets	2								1																					
Basement Floor																														
Corridor	8								2																					
Environmental chemistry	6															4			2											

Toilet	1								1																					
Store	2								1							2														
GC room										3						2														
Instruments room									6							4														
Environmental chemistry	12															8			4											
Environmental chemistry	6															4			2											
Geochemistry Lab	6															4			2											
GLS Lab									6							4														
Environmental toxicology	6															4														
Environmental toxicology									10	1						4														
Microplastic research lab									2	1						2														
Bioremediation Lab	3									2						3														
Molecular biology	12															4														
Environmental biotechnology	3								4							3														
Toilets	3																													
Environmental microbiology	4								2							5														
First Floor																														

(Lab Complex)																													
Corridor	5																												
Store room	2															1													
Chemistry Lab 2	16															8				2									
Maths IV	9															6													
Biology Lab 1	9															6													
Toilets	4	4																	4	2									
Lab	7															9													
Faculty room	2															2													
Total Nos	3332	143	95	0	44	585	6	1	150	142	22	45	188	2024	222	192	27	65	63	55	12	28	1964	85	1	174	98	2	386
Total kW	59.976	0.572	0.475	0	0.352	5.265	0.072	0.018	22.5	5.112	0.88	22.5	5.264	72.9	8.888	2.6888	0.27	0.715	1.134	1.32	0.54	0.84	117.84	8.5	0.06	10.44	4.9	0.24	23.16
Total – 377.38 kW																													

Kunjali Marakkar Hostel

- **ROOMS**

Particular	***Ceiling Fan***	***T8***
Watts	***60***	***36***
Ground /First Floor	***120***	***120***
Second /Third Floor	***180***	***180***
Washrooms		***48***
Quantity	***300***	***348***
Total Power (kW)	***18***	***12.528***

- **STP**

Particular	*Ceiling Fan*	*T8*	*Air Blower*	*Collection Pump*	*Drinking water pump*	*Garden Pump*	*Clarifier Pump*	*Aeration Pump*
Watts	***60***	***36***	***5625***					
Quantity	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**

- **MESS**

Particular	*Ceiling Fan*	*T8*	*LED*	*Exhaust Fan*	*Exhaust Fan*
Watts	***60***	***36***	***20***	***50***	***100***
Quantity	***23***	***5***	***32***	***3***	***1***
Total Power (kW)	***1.38***	***0.18***	***0.64***	***0.15***	***0.1***

II. AIR CONDITIONER LOAD

Location	*Area*	*Type*	*Rated Capacity*	*EER*	*Star*	*Rated Power*	*Year*	*Make*
			TR			*Watts*		
Department of Physics	Magnetics	Split	1	3.8	3	1028	2019	Voltas
Department of Physics	Laboratory	Split	1.5	2.83	3	2300	2009	Voltas
Department of Physics	Laboratory	Split	1.5	2.83	3	2300	2009	Voltas
Department of Physics	Applied Optics	Window	1.5	4.5	5	892	2019	Voltas
Department of Physics	Office	Split	1.5	3.5	3	1129	2018	Voltas
Department of Physics	Office	Split	1.5	3.5	3	1129	2018	Voltas
Department of Physics	XRD	Window	1.5	4.5	5	892	2019	Voltas
Department of Physics	XRD	Window	1.5	4.5	5	892	2019	Voltas
Department of Physics	XRD	Window	1.5	4.5	5	892	2019	Voltas
Department of Physics	Gravity & Cosmology	Split	0.75	2.8	2	937.5		Voltas
Department of Physics	Nano photonics	Split	1.5	4.55	5	885	2019	Voltas
Department of Physics	Nano photonics	Split	1.5	4.55	5	885	2019	Voltas
Department of Physics	Nano photonics	Split	1.5	2.72	3	1842	2010	Godrej
Department of Physics	Nano photonics	Split	1.5	2.72	3	1842	2010	Godrej

Department of Physics	Nano photonics	Split	1.5	3.53	3	1122	2019	Voltas
Department of Physics	Nano photonics	Split	1.5	3.56	3	1109	2021	Voltas
Department of Physics	Nano photonics	Split	1.5	3.56	3	1109	2021	Lloyd
Department of Physics	Complex System group	Split	1.5	4.51	5	808	2019	Voltas
Department of Physics	DSA	Split	1.5	4.51	5	808	2019	Voltas
Department of Physics	Insta	Split	1.5	4.51	5	808	2019	Voltas
Department of Physics	Mag. Lab	Window	1			1250		Whirlpool
Department of Physics	Dream Lab	Split	1.5		3	1875		
Department of Physics	TFD	Window	1.5	2.71	3	1875	2012	Voltas
Department of Physics	TFD	Window	1	2.55	2	1314	2012	Voltas
Department of Physics	TFD	Window	1	2.55	2	1314	2012	Voltas
Department of Physics	TFD	Split	1	3.11	3	1040	2014	Videocon
Department of Physics	TFD	Split	1.5	4.51	5	893	2021	Voltas
Department of Physics	Nest	Split	1.5			1550		Voltas
Department of Physics	Nest	Split	2		5	2500		Voltas
Department of Physics	Nest	Split	2			2500		Voltas
Department of Physics	Nuclear	Split	1.5	4.5	5	892	2019	Voltas
Department of Physics	MML	Split	2	4.5	5	892	2019	Voltas
Department of Chemistry	Raman Spectroscopy room	Split	0.75	2.8	3	920	2010	Onida
Department of Chemistry	Instr. Room 1	Split	1.5	4.75	5	1043	2019	Voltas
Department of Chemistry	Instr. Room 1	Split	1	2.85	2	1230	2013	Samsung
Department of Chemistry	Instr. Lab 2	Split	1.5	3.9	3	1362	2017	Voltas
Department of Chemistry	Seminar Hall	Split	1.5			1910	2016	Voltas
Department of Chemistry	Seminar Hall	Split	1.5			1910	2016	Voltas
Department of Chemistry	Seminar Hall	Split	1.5			1910	2016	Voltas
Department of Chemistry	Seminar Hall	Split	1.5			1910	2016	Voltas
State Bank of India	ATM	Split	1	3.8	3	923	2023	Voltas
State Bank of India	ATM	Split	1	3.8	3	923	2023	Voltas
State Bank of India	Bank Hall	Split	1.5	3.51	3	1544	2019	Voltas
State Bank of India	Manager room	Split	1	3.51	3	776	2019	Voltas
State Bank of India	Bank Hall	Cassete	3			3750		Voltas
State Bank of India	Bank Hall	Cassete	3			3750		Voltas
State Bank of India	Bank Hall	Cassete	3			3750		Voltas
Department of Hindi	Auditorium	Split	1.5			1650		Voltas

Department of Hindi	Auditorium	Split	1.5			1650		Voltas
Department of Hindi	Auditorium	Split	1.5			1650		Voltas
Department of Hindi	Auditorium	Split	1.5			1650		Voltas
Department of Hindi	Auditorium	Split	1.5			1650		Voltas
Department of Hindi	Library	Tower	2.5	2.47		3565	2018	Bluestar
Department of Hindi	Library	Tower	2.5	2.47		3565	2018	Bluestar
Department of Hindi	Library	Tower	2.5	2.47		3565	2018	Bluestar
Department of Hindi	Library	Tower	2.5	2.47		3565	2018	Bluestar
Department of Biotechnology	Library	Split	2	2.55	2	2392	2011	Voltas
Department of Biotechnology	Laboratory	Split	1.5			1875		Voltas
Department of Biotechnology	Hall	Split	2			2500		Voltas
Department of Biotechnology	Hall	Split	2			2500		Voltas
Department of Biotechnology	Hall	Split	2			2500		Voltas
Department of Biotechnology	Hall	Split	2			2500		Voltas
Department of Biotechnology	Dr. Sneha	Split	1.5	3.51	5	1424	2014	Voltas
Department of Biotechnology	Dr. Sayuj	Split	1.5	3.51	5	1424	2014	Voltas
Department of Biotechnology	Dr. Sarita	Split	1.5	3.51	5	1424	2014	Voltas
Department of Biotechnology	Dr. Bhay	Split	1	3.51	3	1250		Voltas
Department of Biotechnology	Nano biotech	Split	1.5	2.68	2	1940	2010	Voltas
Department of Biotechnology	Nano biotech	Split	1.5	4.5		892		Voltas
Department of Biotechnology	Nano biotech	Split	1.5	4.5		892		Voltas
Department of Biotechnology	Microbiology	Split	2	2.75	3	2218	2011	Voltas
Department of Biotechnology	Microbiology	Split	2	3.6	3	2500		Voltas
Department of Biotechnology	Microbiology	Split	1	3.6	3	1250		Voltas
Department of Biotechnology	Microbial	Split	2	2.75	3	2218	2011	Voltas
Department of Biotechnology	Microbial	Split	2	2.75	3	2218	2011	Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	2	3.6	3	2500		Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	2	3.6	3	2500		Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	1		3	1250		Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	1		3	1250		Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	1		3	1250		Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	1		3	1250		Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	1		3	1250		Voltas
Department of Biotechnology	Cells & Molecular Biology	Split	1		3	1250		Voltas

Department of Biotechnology	Cells & Molecular Biology	Split	1		3	1250		Voltas
Department of Biotechnology	HOD	Split	2	5	5	959	2022	Voltas
Department of Biotechnology	Electronics	Split	1.5			1875		Voltas
Department of Biotechnology	Electronics	Split	1.5			1875		Voltas
Department of Biotechnology	Digital Electronics Board	Split	2		5	2500		Voltas
Department of Biotechnology	Digital Electronics Board	Split	1	4.5		1250		Voltas
Department of Applied Electronics	Analytical lab	Split	1	4.51	5	1430	2020	Voltas
Department of Applied Electronics	Analytical lab	Split	1	4.51	5	1430	2020	Voltas
Department of Applied Electronics	Analytical lab	Split	1	4.51	5	1430	2020	Voltas
Department of Applied Electronics	Analytical lab	Split	1	4.51	5	1430	2020	Voltas
Department of Applied Electronics	Seminar Hall	Split	1.5	3.5	5	1714	2016	Godrej
Department of Applied Electronics	Seminar Hall	Split	1.5	3.5	5	1714	2016	Godrej
Department of Applied Electronics	Room Director	Split	1	4.51	5	1250		Voltas
Department of Applied Electronics	Room Director	Split	1	4.51	5	1250		Voltas
SMS	Computer Lab	Split	1			1250		
SMS	Computer Lab	Split	1			1250		
SMS	Computer Lab	Split	1			1250		
SMS	Computer Lab	Split	1			1250		
SMS	Computer Lab	Split	1			1250		
SMS	Hall of Frame	Split	1.5	2.95	3	1728	2013	Voltas
SMS	Hall of Frame	Split	1.5	2.95	3	1728	2013	Voltas
SMS	Hall of Frame	Split	1.5	2.95	3	1728	2013	Voltas
SMS	Hall of Frame	Split	1.5	2.95	3	1728	2013	Voltas
SMS	Classroom (S5,S4)	Split	1			1250		
Mathematics	Auditorium	Split	1	4.7	5	824	2016	Daikin
Mathematics	Auditorium	Split	1	4.7	5	824	2016	Daikin
Mathematics	Auditorium	Split	1	4.7	5	824	2016	Daikin
Mathematics	Auditorium	Split	1	4.7	5	824	2016	Daikin
Mathematics	Computer Lab	Split	1	3.21		1100	2014	Bluestar
Mathematics	Computer Lab	Split	1	3.21		1100	2014	Bluestar
Central Library	Office	Split	3			4058		Voltas
Central Library	Office	Split	3			4058		Voltas
Central Library	Study Lounge	Split	1			1250		Mitsubhushi
Central Library	Study Lounge	Split	1			1250		Mitsubhushi

Central Library	Reference 2	Split	1			1250		
Central Library	Reference 2	Split	1			1250		
Central Library	Reference 2	Split	1			1250		
Central Library	Reference 2	Split	1			1250		
Central Library	E Journals	Split	1.5	3.51	3	1432	2018	Mitsubhushi
Central Library	E Journals	Split	1.5	3.51	3	1432	2018	Mitsubhushi
Central Library	E Journals	Split	1.5	3.51	3	1432	2018	Mitsubhushi
Old Building	Server room	Split	3			1800		LG
Old Building	Audio Visual & Research Centre	Split	1.5	3.72	3	1586	2018	Mitsubhushi
Old Building	Audio Visual & Research Centre	Split	1.5	3.72	3	1586	2018	Mitsubhushi
Old Building	Audio Visual & Research Centre	Split	1.5	3.72	3	1586	2018	Mitsubhushi
Old Building	Audio Visual & Research Centre	Split	1.5	3.72	3	1586	2018	Mitsubhushi
Interuniversity	Classroom	Split	1.5	3.6	3	1355	2018	Voltas
Interuniversity	Classroom	Split	1.5	3.6	3	1355	2018	Voltas
Interuniversity	Faculty post doc	Split	1	3.11	3	1076	2017	Haier
Interuniversity	Chara. Lab 2	Split	1.5	3.6	3	1355	2017	Haier
Department of Statistics	Seminar Hall	Split	1	4.51	5	1133	2020	Voltas
Department of Statistics	Seminar Hall	Split	1	4.51	5	1133	2020	Voltas
Department of Statistics	Seminar Hall	Split	1	4.51	5	1133	2020	Voltas
Department of Statistics	Seminar Hall	Split	1	4.51	5	1133	2020	Voltas
Department of Statistics	Library	Split	2	2.91	3	2113	2012	Voltas
Department of Statistics	Library	Split	2	2.91	3	2113	2012	Voltas
Department of Statistics	Library	Split	2	2.91	3	2113	2012	Voltas
Department of Statistics	Library	Split	2	2.91	3	2113	2012	Voltas
Department of Statistics	Library	Split	1.5	3.52	5	1454	2016	Voltas
Department of Statistics	Library	Split	1.5	3.52	5	1454	2016	Voltas
Department of Statistics	Faculty room	Split	1.5			1875		Voltas
Department of Statistics	Faculty room	Split	1.5			1875		Voltas
Department of Statistics	Research room	Split	1.5		5	1875		Voltas
Department of Statistics	Computer Lab	Split	1	3.51	3	1094	2019	Voltas
Department of Statistics	Computer Lab	Split	1	3.51	3	1094	2019	Voltas
SLS	Seminar Hall	Split	1.5	2.71	3	1860	2009	Voltas
SLS	Mini Hall	Split	1	4.51	5	1132	2021	Voltas
SLS	Mini Hall	Split	1	4.51	5	1132	2021	Voltas

SLS	Director room	Split	2.5			3125		Voltas
Department of English & FL	Office	Split	1			1250		Voltas
Department of English & FL	Faculty room	Split	1.5		3	1428	2018	Voltas
Department of English & FL	Classroom	Split	1			1250		Cruise
Department of English & FL	Classroom	Split	1			1250		Cruise
Department of English & FL	Lab	Split	1.5		3	1458	2018	Voltas
Department of English & FL	Classroom	Split	1.5			1759		Carrier
Department of English & FL	Classroom	Split	1.5			1759		Carrier
IPR Studies	Conference Hall	Split	1.5			1875		Voltas
IPR Studies	Conference Hall	Split	1.5			1875		Voltas
IPR Studies	Conference Hall	Split	1.5			1875		Voltas
IPR Studies	Conference Hall	Split	1.5			1875		Voltas
IPR Studies	Conference Hall	Split	1.5			1875		Voltas
IPR Studies	Visiting	Split	1.5			1875		Voltas
IPR Studies	Director room	Split	1.5			1640		Voltas
IPR Studies	Library	Split	1.5			1600		Voltas
IPR Studies	Library	Split	1.5			1600		Voltas
IPR Studies	Library	Split	1.5			1600		Voltas
IPR Studies	Library	Split	1.5			1600		Voltas
IPR Studies	Library	Split	1.5			1600		Voltas
IPR Studies	Library	Split	1.5			1600		Voltas
IPR Studies	Room	Split	1	4.75	5	839	2017	Bluestar
IPR Studies	Room	Split	1	4.75	5	839	2017	Bluestar
IPR Studies	Room	Split	1	4.75	5	839	2017	Bluestar
IPR Studies	Room	Split	1	4.75	5	839	2017	Bluestar
IPR Studies	Class	Split	1.5	4.75	5	1405	2017	Bluestar
Photonics	Director room	Split	1.5	3.51	5	1510		Voltas
Photonics	Committee	Split	2			2500		Voltas
Photonics	Committee	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas

Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Seminar Hall	Split	2			2500		Voltas
Photonics	Lab	Split	2			2375		LG
Photonics	Lab	Split	2			2375		LG
Photonics	Lab	Split	2			2375		LG
Photonics	Lab	Split	1.5	3.51	3	1411	2020	Voltas
Photonics	Lab	Split	1.5	3.51	3	1411	2020	Voltas
Photonics	Lab	Split	1.5	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	1.5	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	1.5	3.55	5	1802	2016	Voltas
Photonics	Lab	Window	1.5	2.55	2	1882	2012	Voltas
Photonics	Lab	Split	2	2.8		2510	2008	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Window	1.5	2.55	2	1882		Voltas
Photonics	Lab	Window	2			2500		Voltas
Photonics	Computer Lab	Split	1.5	2.55	2	1882	2012	Voltas
Photonics	Room	Split	2		3	1900		Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Photonics	Lab	Split	2	3.55	5	1802	2016	Voltas
Ship Technology	Seminar Hall	Split	2		5	1807	2016	Voltas
Ship Technology	Seminar Hall	Split	2		5	1807	2016	Voltas
Ship Technology	Seminar Hall	Split	2		5	1807	2016	Voltas
Ship Technology	Room 209A	Split	1.5		3	1875		Voltas
Ship Technology	Room 209A	Split	1.5		3	1875		Voltas

Ship Technology	Room 310	Split	1.5			1875		Voltas
Ship Technology	HOD	Split	1.5		3	1654	2016	Voltas
Ship Technology	HOD	Split	2		5	1985	2016	Voltas
Ship Technology	Dept room	Split	1			1250		
Ship Technology Lab Block	L05	Split	1.5			1875		Voltas
Department of Polymer science	Lab	Split	1.5		5	1510	2017	Voltas
Department of Polymer science	Lab 2	Split	1.5		5	1510	2017	Voltas
Department of Polymer science	Lab 3 - 109	Split	1.5		5	1510	2017	Voltas
Department of Polymer science	Lab 3 - 110	Split	1.5		5	1510	2017	Voltas
Department of Polymer science	Lab	Split	1		3	1250		Godrej
Centre of Budget Studies	G02	Split	1.5		5	1875	2017	Hitachi
Centre of Budget Studies	G08	Split	1.5		5	1875		Hitachi
Centre of Budget Studies	G08	Split	1.5		5	1875		Hitachi
Centre of Budget Studies	G08	Split	1.5		5	1875		Hitachi
Centre of Budget Studies	G09	Split	1.5		5	1875		Hitachi
Centre for Integrated	Room 02	Split	1.5			1875		
Centre for Integrated	Room 02	Split	1.5			1875		
Centre for Integrated	Room 08	Split	1.5			1875		
Centre for Integrated	Room 08	Split	1.5			1875		
Centre for Integrated	Room 08	Split	1.5			1875		
Centre for Integrated	Room 08	Split	1.5			1875		
Centre for Integrated	Room 08	Split	1.5			1875		
Centre for Integrated	Room 08	Split	1.5			1875		
Centre for Integrated	Room 11	Split	1			1250		
Centre for Integrated	Room 11	Split	1			1250		
Centre for Integrated	Room 15	Split	1			1250		
Centre for Integrated	Room 20	Split	1			1250		
Centre for Integrated	Room 20	Split	1			1250		
Centre for Integrated	Room 20	Split	1			1250		
Centre for Integrated	Room 21	Split	1			1250		
Centre for Integrated	Room 21	Split	1			1250		
Centre for Integrated	Room 22	Split	1			1250		
Centre for Integrated	Room 22	Split	1			1250		
Centre for Integrated	Room 26	Split	1			1250		

Centre for Integrated	Room 26	Split	1			1250		
Centre for Integrated	Room 26	Split	1			1250		
Centre for Integrated	Room 26	Split	1			1250		
Centre for Integrated	Room 27	Split	1			1250		
Centre for Integrated	Room 27	Split	1			1250		
Centre for Integrated	Room 27	Split	1			1250		
Centre for Integrated	Room 27	Split	1			1250		
Seminar Complex	Entrance Area	Tower	3			3750		Voltas
Seminar Complex	Entrance Area	Tower	3			3750		Voltas
Seminar Complex	Entrance Area	Tower	3			3750		Voltas
Seminar Complex	Main Hall	Package	16.5			20625		Voltas
Seminar Complex	Main Hall	Package	16.5			20625		Voltas
Seminar Complex	Main Hall	Package	16.5			20625		Voltas
Seminar Complex	Main Hall	Package	16.5			20625		Voltas
Seminar Complex	Seminar Hall	Tower	3			3750		Voltas
Seminar Complex	Seminar Hall	Tower	3			3750		Voltas
Seminar Complex	Seminar Hall	Tower	3			3750		Voltas
Seminar Complex	Seminar Hall	Tower	3			3750		Voltas
Seminar Complex	Seminar Hall	Tower	3			3750		Voltas
Seminar Complex	Executive Hall	Split	3			3750		Bluestar
Seminar Complex	Executive Hall	Split	3			3750		Bluestar
Seminar Complex	Executive Hall	Split	3			3750		Bluestar
Seminar Complex	Room 5	Split	3			3750		
Seminar Complex	Committee Hall	Split	3			3750		Bluestar
Seminar Complex	Committee Hall	Split	3			3750		Bluestar
School of Environmental Studies	Conference room	Split	2			2500		Hitachi
School of Environmental Studies	Conference room	Split	2			2500		Hitachi
School of Environmental Studies	Conference room	Split	2			2500		Hitachi
School of Environmental Studies	Conference room	Split	2			2500		Hitachi
School of Environmental Studies	Bet Analysis	Split	2			2500		Hitachi
School of Environmental Studies	Computer room	Split	2			2500		Bluestar
School of Environmental Studies	Library	Split	2			2500		Bluestar
School of Environmental Studies	Director	Split	2			2500		Bluestar
School of Environmental Studies	AAC Lab	Split	2			2500		

School of Environmental Studies	Office	Split	1			1250		Voltas
School of Environmental Studies	GC room	Split	1			1250		
School of Environmental Studies	GLS Lab	Split	2			2500		
School of Environmental Studies	Bioremediation room	Split	1.5			1875		
School of Environmental Studies	Microplastic research room	Split	1			1250	.	
School of Environmental Studies	Molecular biology	Split	1.5			1875		
Admin block			1		5	1250		Voltas
Legal Office			2		5	2500		Voltas
Pay roll (A) section			1.5			1875		Voltas
Finance Office			1.5		5	1875		Voltas
Tech Foundation			1		5	1250		Panasonic
Exam confidential section			1			1250		Panasonic
Exam confidential section			1.5		5	1875		Voltas
Exam confidential section			1.5		5	1875		Voltas
Province Chancellor			1.5		5	1875		
Province Chancellor			1.5		5	1875		
Province Chancellor			1.5		5	1875		
Province Chancellor			1.5		5	1875		
Province Chancellor			1.5		5	1875		
Senate hall			1.5			1875		
DOA Confidential room			1			1250		Voltas
DOA Confidential room			3			3750		Voltas
Director			1		3	1250		
Syndicate hall			1.5			1875		Voltas
VC			1		5	1250		
UC room			5.5			6875		
V/C conference room			1.5			1875		Panasonic
V/C room			1			1250		
UPS room			1.5		5	1875		Voltas
ARIS lab			1.5			1875		Voltas
ARIS lab			1		3	1250		Voltas
International rec			1.5			1875		Voltas
International rec			2		5	2500		Voltas
International rec			2		5	2500		Voltas

International rec			2		5	2500		Voltas
IQAC			1.5		3	1875		
IQAC			1.5		3	1875		
IQAC			1.5		5	1875		
Controller of examination			1			1250		Panasonic
Controller of examination			1.5			1875		Panasonic
Marine block			1.5			1875		Voltas
C room			2			2500		Voltas
C room			2			2500		Voltas
Course in chore			1		3	1250		
Simulation lab			1.5			1875		Voltas
Lab 108			1.5		5	1875		Voltas
Seminar hall			2			2500		Voltas

III. OTHER POWER LOAD

Particulars	***PC***	***Printer***	***Xerox***	***3 in 1***	***Projector***	***Amplifier***	***Kettle***	***Induction***	***Water Dispenser***	***TV***	***Cooler***	***Fridge***
Watts	***110***	***250***	***300***	***300***	***200***	***150***	***1500***	***1500***	***450***	***110***	***250***	***350***
Total Nos	490	71	22	15	25	2	1	5	8	15	9	6
Total kW	53.9	17.75	6.6	4.5	5	0.3	1.5	7.5	3.6	1.65	2.25	2.1
Total	***106.65 kW***											

ANNEXURE-3

LIST OF INSTRUMENTS

Sl.no	Equipment description	Make & model
1	Power Energy & Harmonic Analyser	Krykard ALM 31
2	Power Energy & Harmonic Analyser	Krykard ALM 35

IIABBREVIATIONS

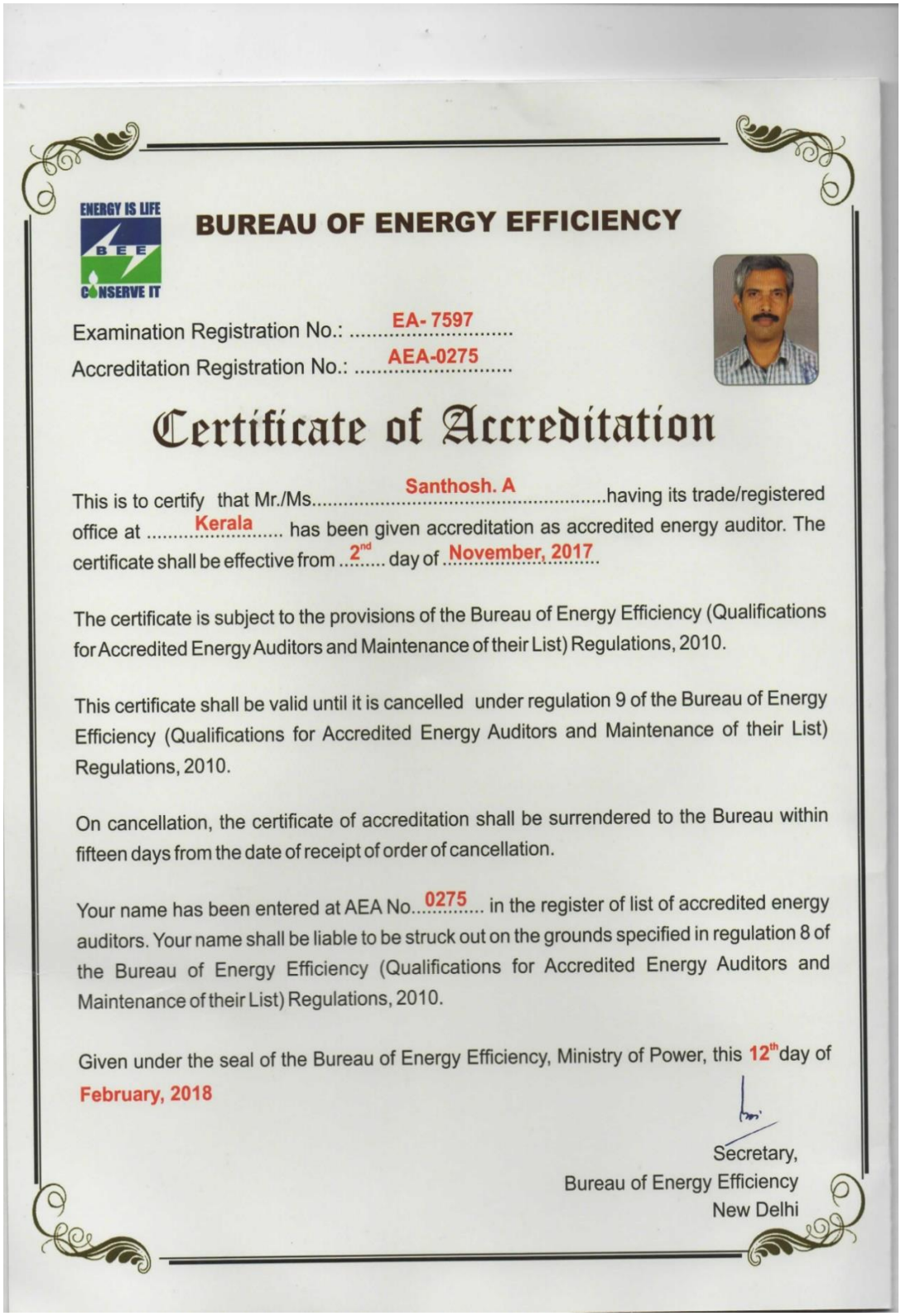
APFC	:	Automatic Power factor Control
AVG	:	Average
BEE	:	Bureau of energy efficiency
BH	:	Boys Hostel
CO_2	:	Carbon dioxide
KSEB	:	Kerala State Electricity Board.
DB	:	Distribution Board
EC	:	Energy Conservation
IEEE	:	The Institute of electrical and electronics engineers
IS	:	Indian Standard
kL	:	kilo Litre
KVA	:	kilo Volt Ampere
kVAh	:	kilo volt Ampere Hour
kVAr	:	kilo volt ampere
kW	:	kilo Watts
kWh	:	kilo watt hour
LH	:	Ladies Hostel
LPG	:	Liquified Petroleum Gas
LT	:	Low tension
MAX	:	Maximum
NSS	:	National Service Scheme
SLD	:	Single Line Diagram
THD	:	Total Harmonic Distortion
TR	:	Transformer

REFERENCES:

- Handbook on energy audit and environment management by TERI.
- Bureau of Energy Efficiency (BEE) books for certification of Energy Auditors & Managers.

CERTIFICATES

I. BEE Accreditation Certificate



ENERGY IS LIFE
BEE
CONSERVE IT

BUREAU OF ENERGY EFFICIENCY

Examination Registration No.: EA- 7597
Accreditation Registration No.: AEA-0275

Certificate of Accreditation

This is to certify that Mr./Ms. Santhosh. A having its trade/registered office at Kerala has been given accreditation as accredited energy auditor. The certificate shall be effective from 2nd day of November, 2017

The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. 0275 in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this 12th day of February, 2018

Secretary,
Bureau of Energy Efficiency
New Delhi

II. EMC Empanelment certificate

Energy Management Centre - Kerala
(Department of Power, Govt of Kerala)

CERTIFICATE OF EMPANELMENT

This is to certify that ***M/s.Athul Energy Consultants Pvt Ltd****(4/2, Capital Legend Building, Korapath Lane, Rouund North, Thrissur)is empanelled as Energy Audit firm in Energy Management Centre Kerala to conduct mandatory energy audit as per Government of Kerala G.O (Rt) No.2/2011/PD dated 01.01.2011.*

Empanelment No:
EMCEEA-0811F-3

Scope/Area	Building	Industry -Electrical	Industry Thermal
	Yes	Yes	Yes

This empanelment is valid up to 01/02/2024
Issuing Date: 02/02/2021
Place: Thiruvananthapuram

Director,
Energy Management Centre - Kerala