DETAILED ENERGY AUDIT, 2022 IN OM DAYAL GROUP OF INSTITUTIONS

OmDayal Group of Institutions
ENGINEERING COLLEGE | ARCHITECTURE COLLEGE

PLOT NO. 38(P),38(A),39(P) & 39(A),
ULUBERIA INDUSTRIAL GROWTH CENTRE, ULUBERIA,
HOWRAH 711316, WEST BENGAL

Conducted By:

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Acknowledgement

We are thankful to the management of the College for giving the opportunity to be involved in this interesting and challenging project on Energy Audit of the main building, Architecture building and two hostels of OmDayal Group of Institutions, College of Engineering at Uluberia, Industrial Growth Center, Uluberia- 711316, West Bengal.

We would be very happy to provide any further clarifications, if required to facilitate implementation of the recommendations.

We received valued cooperation and prompt and untiring support from the concerned personnel from all the departments. We would like to thank particularly to,

Dr. Yoges Kr. Sinha, Principal
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Dr. Kalyan Kr. Mukherjee, Director
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Mr. Sourav Paladhy
Mr. Aswani Sinha
Mr. Md. Jahangir

And also to all the facility executives and staff of the College team who have given full cooperation and support during the audit of the building. They took keen interest and have given valuable inputs during the course of survey.

Sanjoy Bhattacharyya

BEE Certified Energy Auditor

Energy Audit Team:

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Mr. Tanmoy Sur	Project coordinator
Mr. Amar Nath	Audit Assistant

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Executive Summary

1. This section presents a brief summary of the detailed energy audit carried out at the building, during June'22. The study was focused on the energy conservation opportunities in the building operation.
2. During the conduction of the energy audit it was targeted to identify practical, sustainable and economically viable energy savings opportunities in all the equipment/systems of the building resulting from the analysis of the collected data of the building.
3. The institution used to work for five days/week.
4. For this year (July'21 to June'22) nos. of academic days for the student will be 154 days but for the faculties, it will be 210 days and that for offices it will be more or less 247 days.
5. During the audit firstly a walk through survey and there after measurement were made to find out the energy saving potentials in the building with economical viability.
6. The study has identified total annual energy savings potentials of the building. The audit has highlighted the total energy savings with **simple payback period.**
7. During the study, there was a continuous interaction with the institution personnel
8. The three phase power profile clearly indicates unbalance loading condition of the system.Load in yellow phase is almost three times than that of red and blue phase. This phase unbalancing results heating of conducting cable and may result neutral failure due to high neutral current. So, load balance is recommended.
9. Percentage loading of water lifting pump is very low. For energy saving VSD with the existing pump or two/three separate smaller pumps are recommended.
10. In case of any future requirement of AC, please go for star rated AC only and use Inverter AC instead if Split AC, where ever possible.
11. In general, illumination level is on higher side. In some particular areas, as mentioned latter, there is scope of energy saving by minimizing illumination level.

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12. Replace/Retrofit the conventional T12 (40 watt) and T8 (36 watt)by LED Tube of20 watt, resulting reduction of energy at least 25-20 watt per tube.
13. If, replacement/retrofit of the conventional T12 and T8 by 20 watt LED Tube is not possible within a reasonable time, then replace T12 by T8 tube and all conventional chokes by electronic one. By such change, immediate reduction of about 4 watt and 11 watt for each tube and each choke, respectively, is possible.
14. Simply, by replacing resistance type regulator by electronic type, about 10% energy consumption (for each fan) can be reduced.
15. On the roof top of the Main College Building& Architecture Building about 175 kw of solar power generation is possible.

Identified Energy Savings Opportunities:

Table 1

Sl. NO.	Savings Identified	Savings kWh/yr	Savings (Lacs Rs.)	Investment (LacsRs.)	Pay Back Period (Mnth)
1.	If all the 150 nos of T 36 Tube lights are replaced by 20W energy efficient LED Tubes	2953	0.38	0.75	**24**
2.	If all the 100 nos of T40 Tube lights are replaced by 19W energy efficient LED Tubes	1550	0.28	0.50	**22**
3.	Avoiding copier machine in sleeping mode when not in use	80.4	0.083	Nil	**Immediate**
4.	Purchase/Use of Ink Jet Printers in place of Laser Printers	656.52	0.068	0.25	**44**

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5.	Repairing of Damaged Insulation of the Chilled Water line on the college Building Roof.	1422.2	0.147	0.04	**3**
6.	Installation of VSD with each of the water supply pump	2041	0.21	0.53	**3**
7.	Replace old fan with energy efficient BEE star rated Fan	13608	1.36	4.5	**33**
	Total	**22311.1**	**2.528**	**6.57**	**3 to 33**

Total savings in rupees = 2.528 lac/ year

A. Energy Scenario

Table 2

Sl. No.	Energy Scenario: Description	Unit	Apr. 21-Mar. 22
1	Total electrical energy consumption/annum in	kWh	101873
2	Electricity Generated	kWh	199
3	Total electrical energy consumption/annum in College Building and Hostel	kWh	102072
4	Avg. Consumption	kWH/ Year	**102072**
5	Avg. Maxm. Demand	kW	51
6	Total Area of the building (Main + Architecture)	Sqr. Mtr	**11500 +3845= 15,345**
7	Avg. Unit Cost of electricity purchased	Rs./kWh	12.21
8	Cost of Electricity Purchased	Rs. Lakhs	12.43
9	No. Of student	No.	990
10	No of Teaching Staff	No.	30
11	Non Teaching Staff	No.	60

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12	No. Of Working Days		
13	Student	Days	154
14	Teaching Staff	Days	210
15	Nonteaching Staff	Days	247
16	No. Of Man days for utilising Utilities		
17	Student	Man days	152460
18	Teaching Staff	Man days	6300
19	Non Teaching Staff	Man days	14820
20	Total Man days	Man days	173580
21	**Specific Energy Consumption-**	kWh /man days	**102072/173580 = 1.700**
22	**Specific Energy Consumption-**	kWh /covered area in sq.mtr	**102072**/15343 **=6.652**

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Chapter 1
Introduction

OmDayal Group of Institutions

After revolutionizing school education starting with DPS Ruby Park, this group has taken initiative to enter in the field of higher education (Technical& Architecture) with the vision to provide world standard technical education in West Bengal.

- **Overview**

OmDayal Group of Institutions was incepted with a selfless motive – to improve the quality of education in West Bengal and to provide the best facilities so far as knowledge sharing is concerned. Firstly, the need of the hour was to revolutionize education in the school level; so the society laid the foundation stone for DPS Ruby Park. Today this school has become an educational landmark of Calcutta. Now, to raise the bar even higher, in the field of technical education in the state, this group through this technical institution, which is at par with the best private institutes in our country, has opened the door for future generation. With continuous effort, total dedication and continuous improvements,this institution is bringing somechange that will enhance the future of our next generation and our nation as a whole.

- **Vision & Mission:**

  - **Vision**

Vision of this group is to become an institute of repute and to bring about a change in the sphere of technical education in West Bengal by offering a full range of programmes of global standard of education and to transform the students into globally competent personalities.

  - **Mission**

- To provide state-of-the-art resources required to achieve excellence in teaching-learning and supplementary processes.
- To provide Faculty and Staff with the required qualification and competence
- To motivate for their holistic development.

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- To provide opportunity to the students to bring out their inherent talent.

➢ **Quality Policy**

OmDayal College of Engineering and Architecture is committed to provide quality education to the students, enabling them to excel in the fields of Science, Engineering, Technology and Management so that they can contribute meaningfully to the changing and challenging needs of society and industry by

- Contributing to the academic standards and overall knowledge development of the students.
- Providing state-of-the art infrastructure and helpful learning environment.
- Enhancing the competence of faculty to high levels and to make them adopt innovative methods in teaching-learning process.
- Inculcating moral and ethical values among students and staff.

The College Committee has decided to conduct energy audit forreducing the energy cost of the institution. To reduce the energy cost a joint action is required from the management and all the staff, studentsof the college. Staff and student should always try to abide by the basic housekeeping rules as well as following the guideline framed out by the management to reduce energy use and at the same time the management also should always openly appreciate any endeavor taken by the staff and the student.

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Chapter 2

Methodology and Approach

Firstly, we conducted a walkthrough audit when our team discussed the energy related issues with the concerned persons as well as tried to collect energy related information and easily available data.

In the next phase i.e. during detailed audit we took physical measurement of different energy consuming areas, collected the rest of the required data from the management and also tried to understand the operational procedure presently, followed by the operator.

Finally, through various calculations we tried to find out the potential areas where reduction of the energy use/ wastage is possible. After quantifying the saving potential we calculate the investment required in the concluding stage we calculate Simple Pay Back period (where investment is required for implementation of recommendations), so that the management can visualize the whole energy picture at a glance and can find out the most finically viable areas.

The major areas of the study of the building were:

- Electrical Distribution System
- Motors
- Inverter type A/C System
- Split type AC system
- Lighting system
- DG system

Instruments used for executing Energy Audit activities:

The requirement for an energy audit shall involve identification and quantification of energy which would obviously necessitate measurements. These measurements require use of instruments. Instruments have thus been selected in accordance with the parameters, generally required to be measured / monitored during energy audit activities. For undertaking energy audit at the concerned institution, the following key instruments were used.

a) Power Analyser
b) Mastech Lux 1 Luxmeter
c) Compact Hygro Thermometer
d) AC/DC Clamp Meter
e) AVM 07 Anemometer
f) Metal Wired Tape
g) MT 4 Infrared Thermometer
h) Power Meter

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Chapter 3

Service provided by the building with capacity

The main college building of the institution is a fourstoried building having one additional basement. The office is in the ground floor. In the ground floor there are faculty rooms also. All the floors (including basement) have class rooms, laboratories of different streams with modern equipment, libraries, seminar hall etc**.**

Adjacent to the college building, there aretwo-separate hostel buildings one for the boy and the other for girl students. The hostels also are provided with modern facilities. In all of the buildings, AC is the main energy consuming equipment.

a. Transformers 1 no.

b. DG sets –1 no.

- <u>The major energy consuming equipments of the building are:</u>

c. Inverter Type A/C systems

d. Different sizes of A/C (split)

e. 2 nos. Lifts

f. Bore well Pump

g. Water lifting pump

h. Lighting System

i. Fans and exhausts

j. Different energy consuming lab appliances like refrigerator, oven, Oscilloscope, Xerox Machine, Welding, furnace etc.

k. Computers and Printers.

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Chapter 4

Energy Consumption Profile

For providing aforesaid services, the building utilize mainly one type of energy, namely electrical power supplied from WBSEDCL through a transformer of capacity 500 kVA with a contract demand of 80 kVA. This energy is utilized for lighting college buildings and college premises, hostels and also to operate all the electrical equipments including pumps etc. Beside WBSEDCL supplied electricity, it also rarely utilizes HSD for a generator of capacity of 125 kVA which is totally meant for running in case of power interruption. Production of DG is very less as power cut in the college premises is very rare.

Power consumed by the building for the last year (month wise), is given in the table below.

The system power factor (P.F) range is well maintained @ 0.99.Avarage load factor (LF) of the building was found 26.6%during this period. Maximum Demand of the building varied within the range of 47 to 102 kVA with an average of 80 kVA.

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Monthly Energy Consumption for last 12 months is given below:

Table 3

Supplier	WBSEDCL	Customer	Omdayal	Type	E	Tariff Code	E(CT-E1)			Contract Demand		80	kW
Month	**Unit Consump.**	**Unit Rate**	**Energy Charge**	**Max Demand**	**Demand Rate**	**Extra Demand**	**Extra Demand Charge /kVA**	**Billing Demand**	**pf**	**LF**	**Surcharge /rebate on pf**	**Surcharge for Extra Demand**	**Gross Bill Value**
2021-22	**Total**	**Normal**	**Rs.**	**kVA**	**Rs**	**kVA**	**Rs.**	**kVA**		**%**	**Rs**	**Rs**	**Rs.**
Apr-21	11555	777/856/707	89707.35	72	384	0	0	72	0.9859	22.4193	-5895.87	0	134477
May-21	9663	777/856/708	74946.94	52	384	0	0	52	0.9940	25.5665	-5692.67	0	103623
Jun-21	5790	777/775,856/854,707,706	44833.08	44	384	0	0	44	0.9805	18.552	-2726.58	0	69163
Jul-21	10330	775/854/706	80162.45	48	384	0	0	48	0.9918	29.0922	-6278.13	0	111632
Aug-21	10560	775/854/706	81938.55	63	384	11	844.8	63	0.9976	22.5831	-6574.55	844.8	121390
Sep-21	9520	775/854/706	73825.5	52	384	0	0	52	0.9979	25.5174	-5919.08	0	106371
Oct-21	7615	775/773,854/852,706/705	58971.55	44	384	0	0	44	0.9993	23.1718	-4721.35	180.24	36635
Nov-21	8870	773/852/705	68680	44	384	0	0	44	0.9983	27.9192	-5512.61	0	97132
Dec-21	10335	773/852/705	80135.65	44	384	0	0	44	0.999	31.4583	-6444.04	0	109621

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Jan-22	6930	773/852/705	53527.3	44	384	0	0	44	0.9993	21.0888	-4283.14	385.58	80966
Feb-22	10705	773/777,852/856,705/707	83046.77	50	384	0	0	50	0.9866	32.7756	-5461.41	0	116867
Mar-22	14080	777/856/707	109588.2	71	84	19	1459.2	71	0.9975	26.6546	-8802.7	1459.2	155605
Total	**101873**	-	**899363.3**	-	-	**-**	**-**	**-**	-	**-**	**68312.13**	**2869.82**	**1243482**
Avg.	**8489.4**	-	**74946.95**	**51**	**384**	**-**	**-**	**-**	**0.9937**	**25.4677**	**5693**	**-**	**103623.5**

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A) Graphical representation of Unit consumption, Max. Demand**,Gross bill Value,PF and LF of the Building**

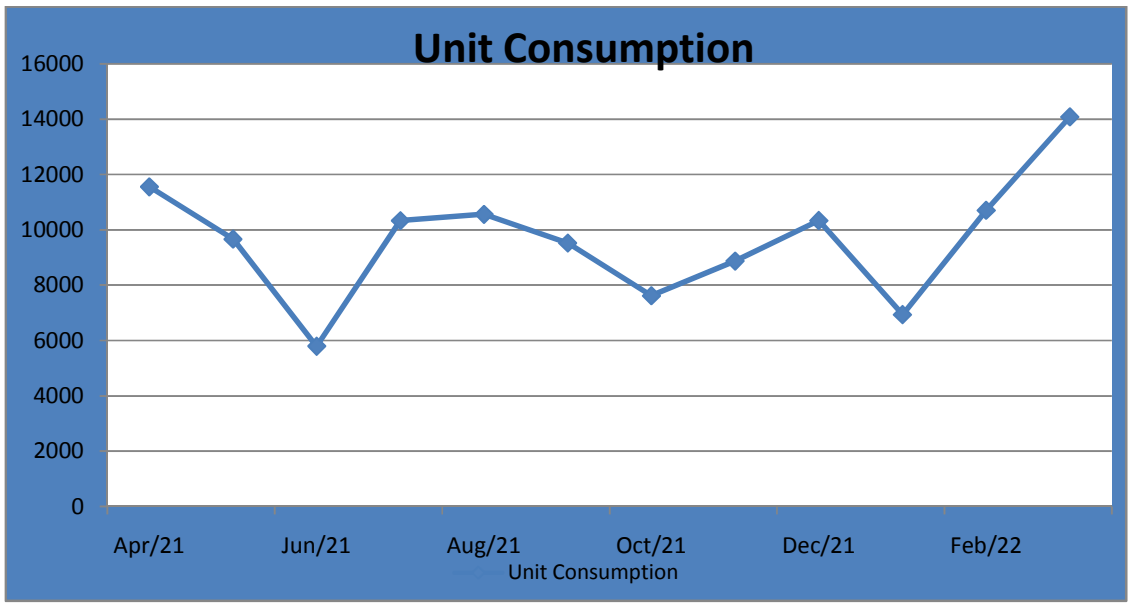

Figure 1

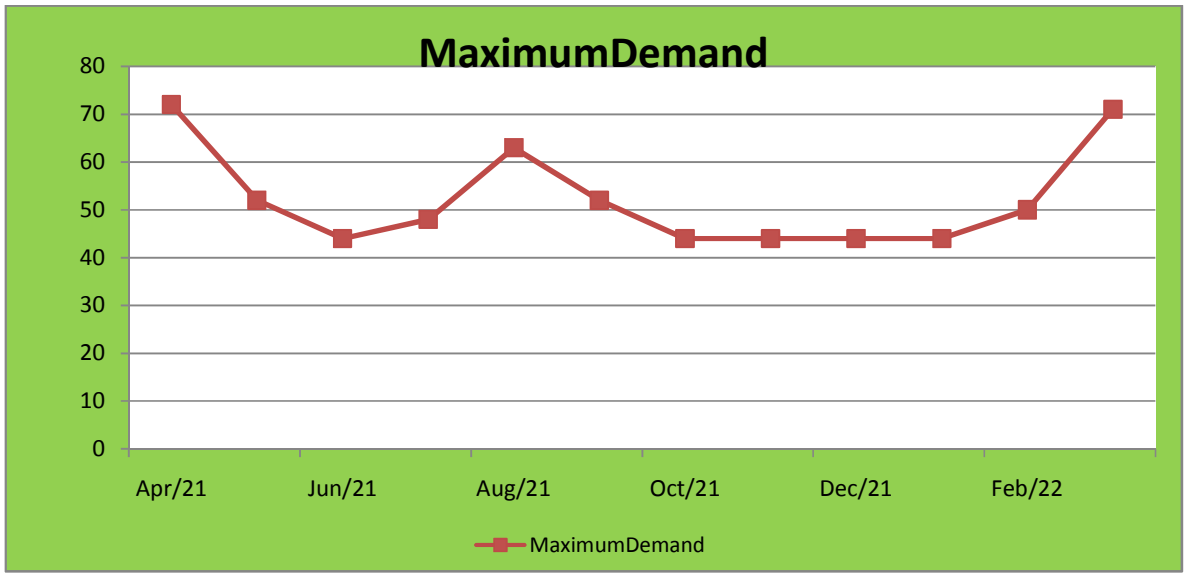

Figure 2

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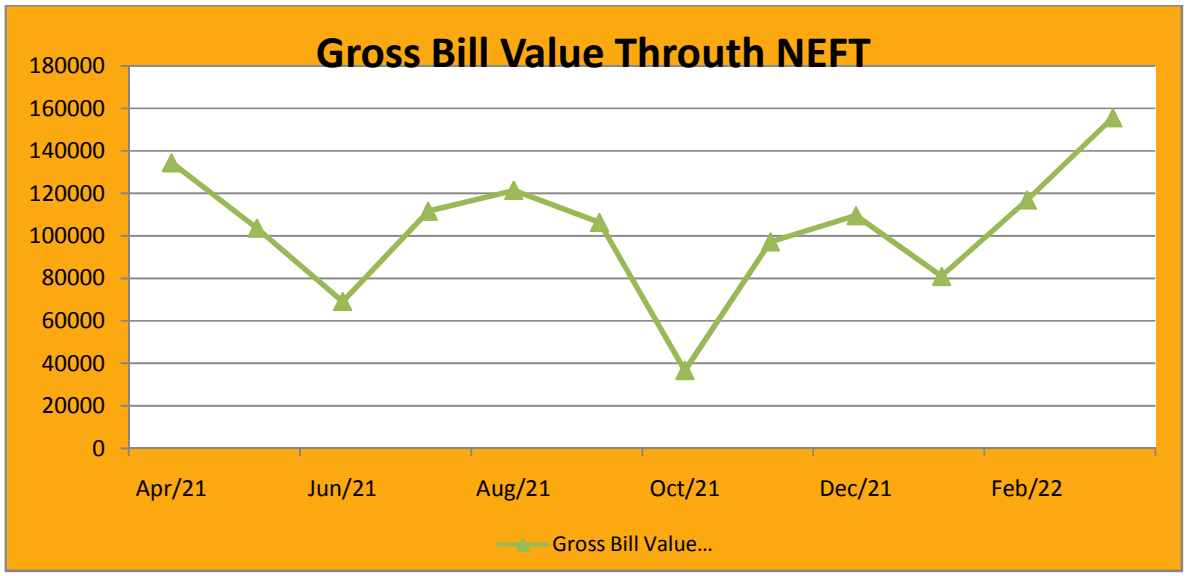

Figure 3

B) **PF and LF**

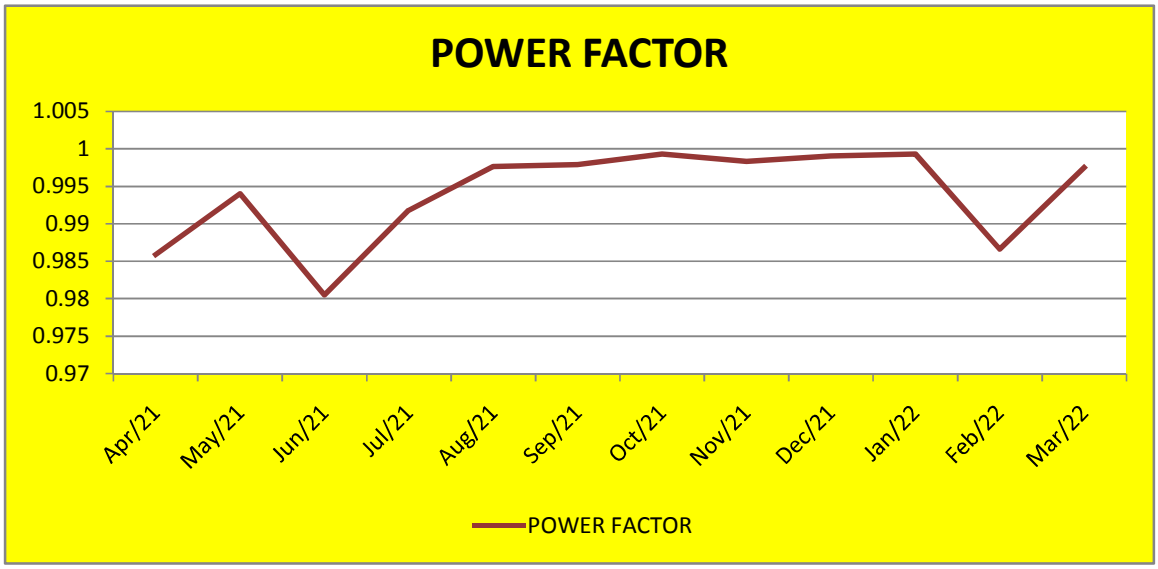

Figure 4.

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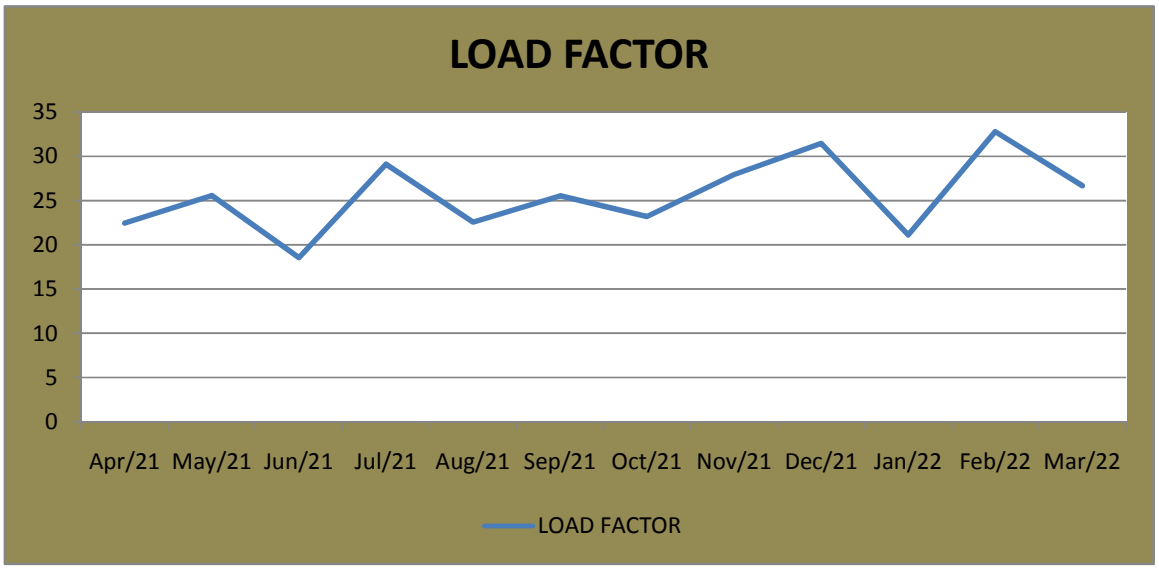

Figure 5

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C) Transformer loading pattern

During our audit survey, we have recorded the loading pattern of the transformers as measured on 07/06/2022. The results of the same are as shown below:

i. Power Profile

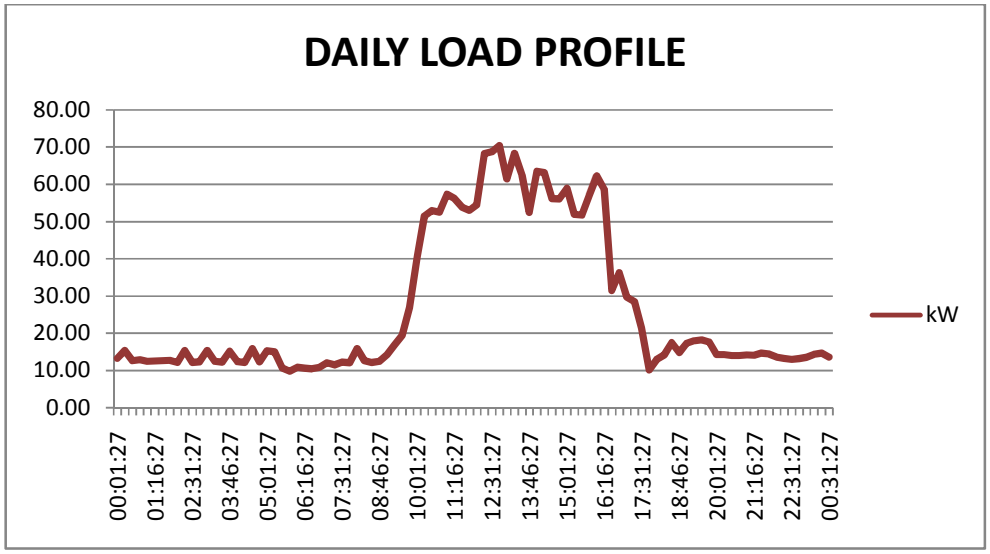

Figure 6

Daily power profile indicates that the power consumption is maximum when classes are in running condition. The lighting and AC load is the main running load of the installation.

ii. Voltage Profile

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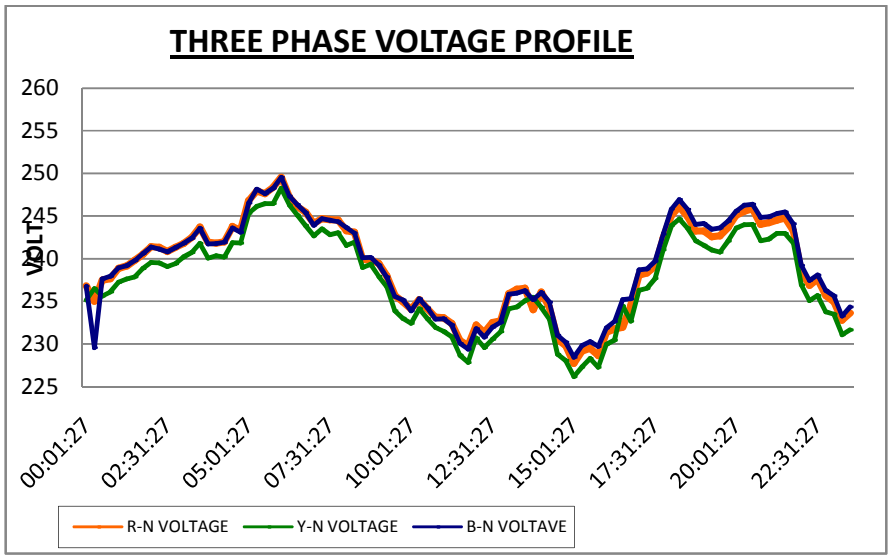

Figure 7

There is no considerable difference between voltage of three phase throughout the day.

iii. Current Profile

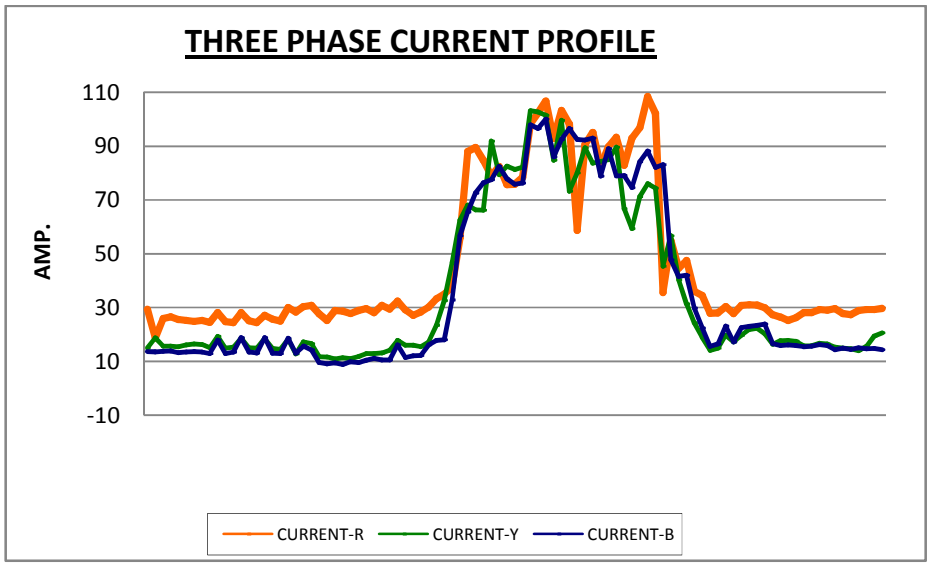

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Figure 8

It is found from the above graph that the current on the red phase is on higher side than other two phase i.e. yellow phase. The yellow and blue phase has the same current like re phase. So there is load in unbalanced condition throughout the day.

iv. Power Factor Profile

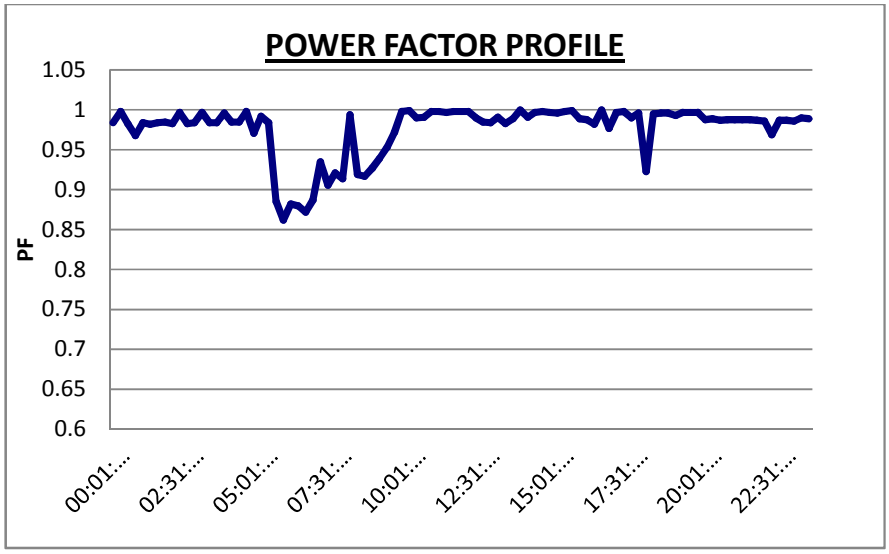

Figure 9

Power factor of the system was in very good condition throughout thewhole time period of study.

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Chapter 5

Source of Power, Distribution and utilization

a) Source of Power

This Institute is receiving power from WBSEDCL through 1 no. transformer of capacity **500 kVA** having a voltage ratio of 11000/433 V.The contract demand of the system is 80 kw. At the time of survey it was learnt that the supply power interruption is very rare. A SLD of the electrical distribution system is shown in fig.7

i. Transformer Details

Table 4

PARTICULARS	DETAILS
MAKE	ELECTROTECKNICK SWITCHGEARS PVT. LTD.
TYPE	DRY TYPE
KVA RATING	500
RATED H.V/L.V VOLTAGE (V)	11000 / 433
RATED H.V/ L.V CURRENT (AMP)	23.24 / 666.7
PHASE	3
MAKER'S SERIAL NO.	TST 1174
TYPE OF COOLING	AN
FREQUENCY (HZ)	50
IMPEDENCE VOLTS	5.0 %
INSULATION CLASS	C
YEAR OF MFG.	08. 2010

ii.DG Details

In the CollegeBuilding there is one of number DG set for emergency power supply. Details of DG is as follows-

DG DETAILS

Table 5

PARTICULARS	DETAILS
MAKE	JACKSON. LTD.
MODEL	JSPF 125 FL
KVA RATING	125
RATED H.V/L.V VOLTAGE (V)	415
PHASE	3
MAKER'S SERIAL NO.	CJS - 44036645
FREQUENCY (HZ)	50
YEAR OF MFG.	03/2011

Remark: It was observed that there is no energy meter in diesel generator set. It is suggested to install energy meter and record the energy generation of DG set regularly.

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b) Electrical Power Distribution Diagram

Electrical power distribution system i.e. single line diagram (SLD) of the system has been shown through a simplified diagram.

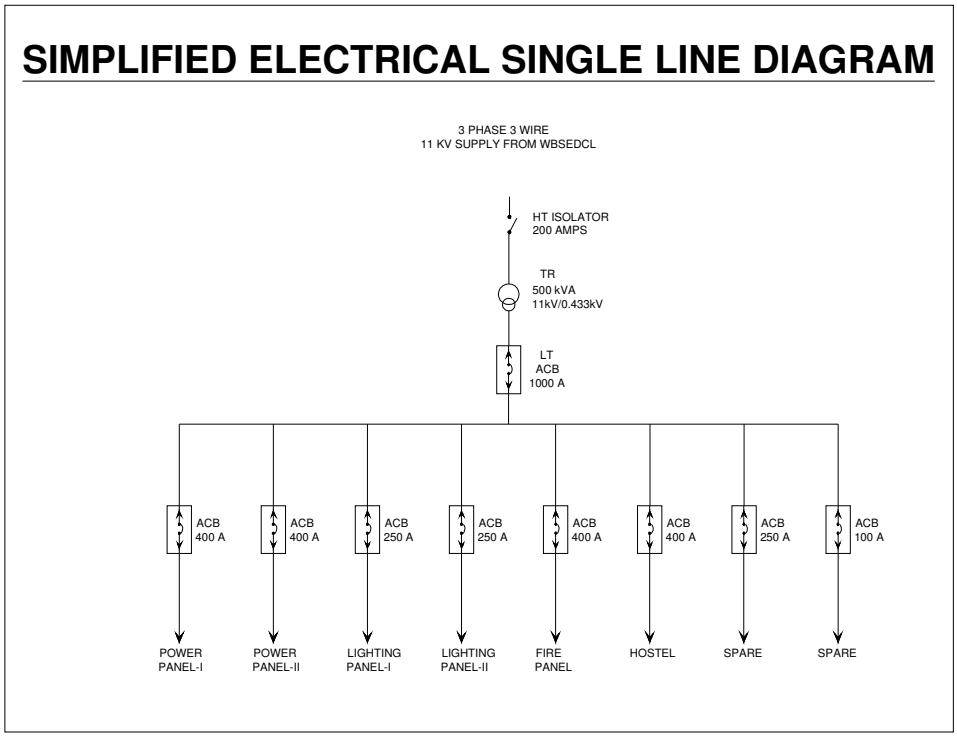

Figure 10

c) Load Summary of the building

The distribution of connected load along with the percentage load of different section is shown below:

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Table 6

SL	Load Details	kW	Load %
A	Lighting Load	112.37	29.72%
B	Fan Load	62.55	16.54%
C	Computer & Small Power	17.14	4.53%
D	Air Conditioner	115.06	30.43%
E	Utility Services Pump, Lift etc	22.7	6.00%
F	Lab Equipment	48.33	12.78%
	Total	378.14	100.00%

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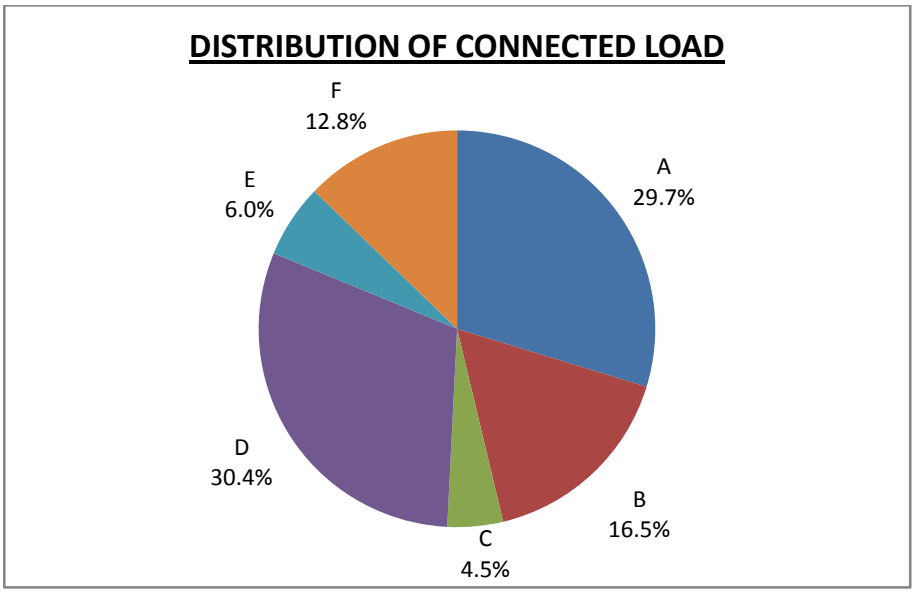

Figure 11

A load distribution of the total building is shown above. From the above chart it is observed that major load (30.4%) of the building is due to the AC system. Lighting system contributes the next highest load (30.4%).Then comesfan load (16.54%), lab equipment (12.78%), utility services e.g. pumps and lifts etc (6%).

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Chapter 6

Electric Drives and Electrical Apparatus

6.1 Facility Description

The energy audit of motors in the building was carried out to study, analysis and identify the potential for energy conservation in motors. The plant makes use of both squirrel cage induction motors and slip ring motors for LT application.

The LT drives were mainly used in all motive applications starting from, water pumping units, cooling, fans and Air Conditioning system. All the LT motors were of 415V /433 V.

Excepting motor there are muchother electrical energy consuming equipment like furnace, welding machine, different electrical and mechanical testing machine etc.

Detail list of electrical energy consuming machine is given bellow (Table-7)

Table 7

Sl No.	Load Details	Quantity No.	Unit Load kW	Total Load kW
1	Lift	2	6.6	13.2
2	Submersible Pump	1	5.5	5.5
3	Water Lifting Pump	1	4	4
4	Chillers		4.8	0
5	Chillers Feed Water Pump	1	0.37	0.37
6	Condenser Fan	1	0.37	0.37
	Mechanical Workshop			
7	Blower	1	0.37	0.37
8	Muffle Furnace	1	2	2
9	Grain fineness tester	1	1	1
10	Clay Washer	1	0.1	0.1

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11	Welding Set (Arc)	1	4	4
12	Welding Set (Arc)	1	3.5	3.5
13	Spot Welding	1	4	4
14	MIG Welding	1	2	2
	Additional Workshop No.4(Room No.6015-16)			
	R-15			
15	Universal Testing Machine	1	3.7	3.7
16	Torsion Testing Machine	1	0.37	0.37
17	Fatigue Testing Machine	1	1.5	1.5
18	Polishing Machine	1	1	1
	R-16			
19	Motorised Gyroscope	1	0.125	0.125
20	Universal Governor Apparatus	1	0.37	0.37
21	Static & Dynamic Balancing M/C	1	0.125	0.125
22	Cam Analysis M/C	1	0.37	0.37
23	VIB	1	0.125	0.125
24	**Quick Return M/C**	1	0.37	0.37
	Lab – 12			
25	CNC Testing M/C	1	10	10
	Lab – 17			
26	Motor	2	0.37	0.736
27	Motor	1	3.7	3.7
	Lab – 16	1		
28	Oscilloscope	3	0.105	0.315
29	Signal Generator	1	0.05	0.05

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	Lab - 14 (Chemical Lab)			
30	Digital Hot Air Oven	1	2	2
31	Osham	3	1.5	4.5
32	Water Bath	1	1	1
33	Water Heater	1	1	1
	Total Power Load			**71.766**

6.2 Observations, Analysis and findings of motors

i. The operating power parameters of LT motors were measured using power analyzer instrument to observe load profile and power consumptions. The range of percentage of motor loading in different section is analyzed and shown in Table 8

The variation in percentage loading is mainly due to

- Over sizing of motors
- Low operating efficiency of the driving equipment itself.
- Chance of using burn out (re-winded) motors.

The instantaneous power measurement details of LT motors of different units and other consuming areas are given in the **Table no. 8**

ii. **Motor and Energy Consuming Loading Pattern in the building**

The operating voltage of LT motors measured varies from **400 402 V** with frequency variation of 49.4 Hz to 50.1 Hz. The instantaneous power measurement carried out for LT motors in the building are given in appendix. Table 6gives the operating load of LT motors and their % loading:

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Loading of LT Motors

Table 8

SL. No.	Equipment	**Voltage V**	Current Amp			Measured Power	Rated Power	% loading
		Average	R	Y	B	kW	kW	
1	Lift-1	402.5	7.4	7.4	7.2	2.874	6.60	59.5%
2	Submersible Pump	401.4	7.2	7.5	7.7	4.52	5.50	71.6%
3	Water Lifting Pump	400.4	3.2	3.5	3.3	1.67	4.00	36.4%
Note:	**A) Water lifting pump (Sl.No.3): is meant for lifting water from the reservoir at basement to the tank at the roof of the two hostels and admin Building i.e for the three systems. Sometimes water is required to be lifted not in all the three system at a time but may be required to lift in one /two buildingsonly. In that case the pump will run inefficiently as the percentage loading of the pump will be lower (as shown in Sl. No. 3 above). To avoid such loss VSD may be installed with the existing pump unit or two/three separate smaller pumps can be used. However, before any step is taken further investigation in detail including all possible operationalmodes is to be analyzed.** **B) Submersible pump (Sl.No.3): So far as % loading is concerned it shows it is almost OK.** **C) Lift (Sl. No. 1): From the table it is clear that when the measurement was taken the lifts were moving almost in no load condition.** **D) The voltage level foundsatisfactory at the time of measurement .**							

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Chapter 7

Air Conditioner

In the building there are 32 nos. of air conditioner of total capacity 99.9 TR. It is observed that most of the large units are inverter type cascade AC and small units are star rated AC. It is wise to use Inverter type AC, wherever possible, so far as energy consumption is concerned. Compare to inverter type AC, star rated inverter type ACs are more energy efficient. The dtails of AC load are given below:

Table:9

Sl No.	Location	Type	TR	Quantity	Unit Load	Total Load	TR
1	Security	Split	1	1	1.17	1.17	1
2	Lab No.12 (CNC Lab)	Carrier Split	1.5	2	1.9	3.8	3
3	Server Room	Toshiba Invertor	2	2	1.9	3.8	4
4	Seminar Hall	Mitsubishi, Invertor	4	3	4.14	12.42	12
5	Language Lab	Split	2	1	2.42	2.42	2
6	Lab (electronics) 2.3	Toshiba Inverter	4	4	4.14	16.56	16
7	Computer Lab	Toshiba Inverter	4	4	4.14	16.56	16
8	Principle Room	Carrier Split	1.5	1	1.9	1.9	1.5
9	Office	Toshiba	4	2	4.14	8.28	8
10	Deputy Registered & VP Room	Carrier Make Split	1	2	1.12	2.24	2
11	Office Board Room, 6115	Carrier Make Split	2	1	2.41	2.41	2

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12	Guest house	Split	1.5	3	1.9	5.7	4.5
13	Architecture Building Conference Hall	Toshiba Ductable	8	3	11.2	33.6	24
14	Architecture Building Server Room	Toshiba Split	1.2	2	1.2	2.4	2.4
15	Architecture Building HOD Office	Toshiba Split	1.5	1	1.8	1.8	1.5
				32		115.06	99.9

Advantages of inverter type AC over 5 star non-inverter type is given below for better understanding-

- **The non Inverter type AC's power consumption depends on its star rating.**
- **During its total operational period, its compressor remains in running condition for about 70% of the total operational time.**
- **Inverter type AC, on Start up, consumes about 20% more power for about 45 mins to 1 hour.After that it consumes lesser power (about 50%) just to maintain the set temperature.**

Comparison between 5 star non inverter and inverter type 1 ton AC:

- **A 5 star non inverter**1 ton AC will consume around 1000 watt power to maintain its minimum efficiency.
- So if it runs for 8 hours it will consume 1000 x 70% x 8 = 5584 = 5.584 kwh
- **An inverter type** AC of same capacity when runs for same 8 hrs will consume 1000 + (1000 x 20%) = 1200 = 1.2 kwh for first 1 hr.
- For next 7 hour it will draw (1000 x 0.5 x 7) = 3.5 kwh
- Total power drawn byinverter type AC = 1.2 + 3.5 = 4.7 kwh

Hence, Power saved by using inverter type over non inverter type in percentage =

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(5.584 – 4.7)/5.584 = 0.884/5.584kwh = 15.8% **say 16%**

- **Inverter type AC may save even more if room is well insulated.**

Power Consumption pattern of starinverter and Star non-inverter type air conditioners, based on data from BEE in 2017is shown in (Table 9).

Table 10

	0.75 ton	**1 ton**	**1.5 ton**	**2 ton**
3Star Non Inverter	627kwh/yr	828 kwh/yr	1235 kwh/yr	1548 kwh/yr
5Star Non Inverter	576 kwh/yr	760 kwh/yr	1130 kwh/yr	1412 kwh/yr
3 Star Inverter	550 kwh/yr	726 kwh/yr	1077 kwh/yr	1344 kwh/yr
4 Star Inverter	499 kwh/yr	658 kwh/yr	972 kwh/yr	1208 kwh/yr
5 Star Inverter	421 kwh/yr	557 kwh/yr	815	1005 kwh/yr
Annual Electricity Consumption Units(kWh) for 1600 hrs *(based on data from BEE)*				

Observation and remarks:

- **Forany future requirement/ replacement, pl. try to go for Star rated AC only.**
- **Where ever possible, pl. go for Inverter AC instead of Split AC.**

A list of AC along with its instantaneous measured values with comments is given below in

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Table 11

Sl. No.	Reference of AC	Make & Type	Rated Capacity (TR)	Room Set Temperature(oc)	Rated Capacity (kW)	TR Developed	kW/ TR	EER (kW/ kW)	Remark
1	Principal Room AC	Carrier & Split	1.5	24	1.9	0.89	1.57	2.24	OK
2	Server Room AC-1 6107	Toshiba & Split	2	23	2.4	1.27	1.26	2.79	OK
3	CNC Lab AC-1	Carrier & Split	1.5	23	1.9	1.48	1.08	3.25	OK
4	CNC Lab AC-2	Carrier & Split	1.5	23	1.9	0.58	1.34	1.28	Condition is poor
5	Computer Room AC-1 6116/1	Toshiba & Inverter Cassette	4	23	4.58	3.12	1.41	2.49	OK
6	Computer Room AC-2 6116/1	Toshiba & Inverter Cassette	4	23	4.58	3.23	1.36	2.58	OK
7	Computer Room AC-1 6116/2	Toshiba & Inverter Cassette	4	23	4.58	3.12	1.41	2.49	OK
8	Computer Room AC-2 6116/2	Toshiba & Inverter Cassette	4	23	4.58	3.01	1.46	2.41	OK
9	Office AC-2 Room No.6115/2	Toshiba & Inverter Cassette	4	23	4.58	3.29	1.34	2.63	OK
10	Office AC-1 Room	Toshiba & Inverter	4	23	4.58	3.46	1.27	2.76	OK

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	No.6115	Cassette							
11	V.P's Room	Carrier & Split Two Star	1.2	23	1.4	3.01	1.46	2.41	OK
12	Office Room Front	Carrier & Split Two Star	1.2	23	1.4	3.01	1.46	2.41	OK
13	Secretaries Room	Carrier & Split Two Star	1.2	23	1.4	3.01	1.46	2.41	OK
14	Seminar Hall AC-1 6107	Mitsubishi, Invertor	4	23	4.58	3.01	1.46	2.41	OK
15	Seminar Hall AC-2 6107	Mitsubishi, Invertor	4	23	4.58	3.01	1.46	2.41	OK
16	Seminar Hall AC-3 6107	Mitsubishi, Invertor	4	23	4.58	3.01	1.46	2.41	OK
17	Lab-3, AC-1 6113	Toshiba & Inverter Cassette	4	23	4.58	3.23	1.36	2.58	OK
18	Lab-3, AC-2 6113	Toshiba & Inverter Cassette	4	23	4.58	2.34	1.88	1.87	OK
19	Lab-2, AC-1 6112	Toshiba & Inverter Cassette	4	23	4.58	3.01	1.46	2.41	OK
20	Lab-2, AC-2 6112	Toshiba & Inverter Cassette	4	23	4.58	3.01	1.46	2.41	OK
21	Architecture Building Conference Hall, AC-1	Toshiba Ductable Package	8	23	8.8	7.14	1.20	2.92	OK

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22	Architecture Building Conference Hall, AC-2	Toshiba Ductable Package	8	23	8.8	6.61	1.30	2.70	OK
23	Architecture Building Server Room AC-1	Toshiba & Split	1.2	23	1.4	1.11	1.17	3.00	One Stand by, OK
24	Architecture Building Server Room AC-2	Toshiba & Split	1.2	23	1.4	1.06	1.23	2.86	One Stand by, OK
25	HOD Office	Toshiba & Split	1	23	1.2	1.11	1.13	3.10	OK

It is suggested to keep close the window, door, any hole or gap to the atmosphere, rapid operation of door, not to use of gas/electrical heater in the air conditioning room. As the indoor unit is on the false ceiling dust were accumulated rapidly, so needed to be clean more frequently.

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Chapter 8

Lighting System of the Building

i. Facility Description:

The institution makes use of different types of lamps and luminaries for different application. Various types of lamps presently used are: 36 watt FLT, 40 watt FLT, **36** wattPL, 25wattFLT, 14 watt CFL, etc.

For outside lighting, erection activities **of Solar Street Lighting system with 20 watt LED lamp set with 75WP solar panel of 10 Nos. have been installe** .Presently, for outside lighting mainly 400/500 watt Metal Halide are in use.

ii. General Observation:

- In the building, in many places, energy efficient CFL/FTL have been used.
- Most of the outdoor lighting (solar lighting) have provision to be operated with timer.
- In some places the fluorescent lamps of 40 watt are observed to be fitted with conventional aluminum/copperchokes.
- Some fans are found to be fitted with conventional (resistance type) regulator.
- Sometimes it was found that fans and lights are in runningcondition in empty rooms.
- Dust has been accumulated on some of the lights/light fittings.

iii.Recommendations:

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- Replace/Retrofit the conventional T12 (40 watt) and T8 (36 watt)by LED Tube of20 watt,resulting reduction of energy at least 25-20 watt per tube.
- If, replacement/retrofit of the conventional T12 and T8 by 20 watt LED Tube is not possible within a reasonable time, then replace T12 by T8 tube and all conventional chokes by electronic one. By such change, immediate reduction of about 4 watt and 11 watt for each tube and each choke, respectively, is possible.
- Simply, by replacing resistance type regulator by electronic type, about 10% energy consumption (for each fan) can be reduced. So, replace all resistance type regulator by electronic type,
- By introducing better housekeeping, including awareness development, further saving of energy up to 2% to 3% is possible.
- Clean the light/light fittings time to time. This will increase the illumination level.

Lighting details of the college building is given bellow-

Table 12

SL. NO.	LOCATION	LUMINIERE DETAILS (NO.)	LUMINIERE DETAILS (NO.)	TOTAL CIRCUIT WATTS (W)
MAIN BUILDING				
1	Mech. Engg. 1st Year Room No.6021	36W FLT 8 Nos		352
2	Computer Lab-03 Room NO.6113	36W FLT 6 Nos		264
3	Electrical Engg. 1St Year Room NO.6120	36W FLT 8Nos		352

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4	Common Room 6119	36W FLT 8Nos.		352
5	Faculty Room CSE 6109,6110,6111	28W FLT 1No	18W PL 18No	354
6	Lab-21 Room No. 6101	36W PL 27Nos.		972
7	Canteen	36W FLT 3Nos.	20W LED TUBE 4Nos	212
8	Kitchen Area	-	20W LED TUBE 4Nos	80
9	Dining Place beside kitchen	FLT 20W 3 Nos	36W FLT TUBE 4Nos	104
10	6102 Lab - 20	36W FLT 12 Nos		528
11	LAB-2(Computer lab) 6112	36W FLT 4 Nos		144
12	6103 LAB Electrical	44W FLT -16 Nos		704
13	6104 Electrical Lab	36W FLT 12 Nos		528
14	6106 Electrical Lab	36WFLT 16 Nos		576
15	6107 Seminar Hall	36W CFL 54Nos	`	2376
16	6117 Call Centre	36W FLT 6Nos	20W LED TUBE 2Nos	304
17	CSE 1ST YEAR 6118 1ST Floor	36W FLT 12Nos		528
18	CSE 4TH YEAR 6223	36WCFL 21Nos		756
19	Mech. Engg. 4th year 6222	36WCFL 21Nos		756
20	Lab rotary Main	36W CFL 20Nos		720
21	Library outside	36WCFL12 Nos		432
22	Electrical 4th year 6219	36WCFL 18 Nos		648

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23	LAB 30 6215	36W FLT TUBE 12 Nos		432
24	1st Floor Lab 29 6218 Digital electronics	36W CFL 18Nos		648
25	LAB 28 6217	36W CFL 15Nos		540
26	Faculty Room CE 6211,6212,6213	36WFLT 6Nos		216
27	Class Room 6201	36WFLT 24Nos		864
28	LAB 22 6202	36W CFL 18Nos		648
29	LAB 23 6214	36W TUBE 12 Nos		432
30	LABE 6203	36W CFL 48Nos		1728
31	1st Floor Civil Eng. 4th floor 6204	36W CFL 27Nos		972
32	Faculty Room EE 6206 TO 6208	36W CFL 15Nos		540
33	Computer Hal-4 6209	36W CFL 24 Nos		864
34	Drawing Hall 6210	36W CFL 36 Nos		1296
35	Computer Hall 6116	36 W CFL 18Nos		648
36	Stat Lab	36W CFL 27 Nos		972
37	3rd Floor Civil ENGG 3RD YEAR 6329	36W FLT 18Nos		792
38	Class Room Electronics 6326	36WFLT 12 Nos		432
39	Research Room 6328	36WFLT 12Nos		528
40	LAB-2 6319	36W FLT 12Nos		528
41	G Y M-1 6323	36WFLT 8Nos		288
42	GYM-26324	36WFLT 8Nos		288

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43	Faculty Room 6312,6313,1314	36WFLT 8Nos		288
44	2nd FLOOR Seminar Hall 6301	36WFLT 24Nos		864
45	Lab 39 6302	36WFLT 12Nos		528
46	Corridor Lighting	36WFLT 34Nos		1496
47	Computer Lab-5, 6315	36WFLT 7Nos	20WLED 4Nos	388
48	Civil Eng. 2nd year 6303	36WFLT 12Nos		528
49	Mech. Engg. 2nd year 6304	36WFLT 20Nos		720
50	Faculty Room 6306,6307,6308	36WFLT 10 Nos		360
51	2nd Floor I Q A C 6317	36WFLT 6Nos		216
52	Class Room 6309	36WFLT 8Nos		288
53	Elec. Engg. 2nd year 6310	36WFLT 6 Nos		264
54	Geology 6311	36WFLT 18 Nos		792
55	Ground Floor, Tutorial Room 6124	36WFLT 8Nos		352
56	Ground Floor Corridor	36WFLT 22Nos	12WLED 23Nos	1244
57	Ground Floor Office 6115	36WCFL 6Nos		264
58	1st Floor Corridor	36WFLT 27 Nos	20WLED 12Nos 14WCFL 6Nos	1512
59	Server Room 1st Floor	36WPL 6Nos	23WCFL 1	287
60	BASEMENT LAB 10 6008	20WLED Tube 4Nos		80

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61	Lab 11 6009	36WFLT 3Nos	20WLED Tube 2 Nos	172
62	LAB 12 6010	36WLED 5Nos		180
63	Store 6017	36WLED 4 Nos		144
64	Lab -13 6411	36WLED 12Nos		432
65	Basement Corridor	36WFLT 28Nos		1232
66	Addl. Workshop-4 6015 & 6016	36W FLT - 16Nos		704
67	Addl. Workshop -3 6014	36W FLT 14Nos		616
68	Lab -5 6013	36W FLT 18Nos		792
69	Lab 6002	36WFLT 6Nos		264
70	Lab -7 6001	36W FLT 10Nos		440
71	Lab -1 6007	36W FLT 8 Nos		352
72	Lab -1 6005	36W FLT 12Nos		528
73	Ground Floor Principal Room	36W FLT 2Nos	20W LED 3Nos	148
74	3rd Floor Gym. Room 6423	36W FLT 8Nos		352
75	Room 6422	36W FLT 12Nos		528
76	Room No- 6421	36WFLT 12Nos		528
77	Room No 6413	36WFLT 10Nos		440
78	Room No 6414	36W FLT 20Nos		880
79	Room No 6415	36W FLT 24Nos		1056
80	Room No 6419	36W FLT 16 Nos		704
81	Room No 6418	36W FLT 12Nos		528

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82	Room No 6411	36W FLT 8Nos		352
83	Room No 6417	36W FLT 24Nos		1056
84	Room No 6416	36W FLT 22Nos		968
85	Faculty Room 6407,6408,6409	36W FLT 19Nos		836
86	Room No 6401	40W LED 29Nos		360
87	Room No 6402	40W LED 2Nos		80
88	Room No 6410	40 W LED 5 Nos		200
89	Room No 6403	36W FLT 46 Nos	12W LED 6Nos	2096
90	Room No 6412	40W LED 12 Nos		480
91	Room No 6405	36W FLT 12 Nos		528
92	Room	36W FLT 42Nos		1848
ARCHITECTUREERE BUILING				
93	Ground Floor Common Passage	36W FLT 14Nos		616
94	M R- 1	36W FLT 4Nos	24W LED 1 Toilet	200
95	M R - 2	14W LED -41Nos		574
96	M R - 3	36W Tube 13Nos		468
97	Seminar Hall	36W TUBE 6Nos	14w squer led 2Nos	244
98	A R Workshop	36W FLT 22 Nos		968
99	Architecture Building 1st Floor Office Room 9109	36W FLT 34Nos		1496
100	Library & Reading Room 9110	36W FLT 18 Nos		792
101	HOD Office	36 W FLT 8Nos		352

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102	HOD Office	36W FLT 34Nos		1496
103	Corridor 1st Floor	36W FLT 60 Nos		2640
104	Wash Room	36W FLT 4 Nos		176
105	Faculty Room	36W FLT 42 Nos		1848
106	Class Room 9101	36 W FLT 36 Nos		1936
107	Class Room 9102	36 W FLT 36Nos		1936
108	Class Room 9105	36W FLT 42 Nos		1848
109	Faculty Room9106	14W LED 42Nos		588
110	Class Room 9107	36 W FLT 28Nos		1232
111	Class Room 9103	36 W FLT 12Nos		528
112	Architecture Building 2nd Floor Class Room 9205	36 W FLT 8 Nos		352
113	Class Room 9203	36W FLT 12Nos		528
114	Class Room 9208	36 W FLT 52 Nos		2288
115	Class Room 2 9207	36 W FLT 56Nos		2464
116	Class Room 3 9202	14W LED 44Nos		616
117	Lobby	29W LED TUBE 14Nos		406
118	LAB - 2 9201	36W FLT 58Nos		2552
119	Faculty Room	36W FLT 36 Nos		1936
120	Faculty Room 9205	36 W FLT 6 Nos		264
121	Faculty Room 9206	36W FLT 18Nos		648
122	Class Room 9210	36W FLT 18 Nos		648
123	Class Room -5 9210	36 W FLT 28 Nos		1008

124	3rd Floor Hall	36W FLT 18Nos		648
125	Toilet	36W FLT 14 Nos		504
126	Architecture Building 3Rd.Floor Mechanical House 9311	36W FLT 34 Nos		1224
127	S - 9 9309	36 W FLT 42 Nos		1512
135	Common Room 9305	400W MH-6		2400
136	Lab 9301	36W FLT 18Nos		648
137	Lab 9302	36W FLT 18 Nos		648
138	Model Room 9306	36 W FLT 28 Nos		1008
139	Model Room 9303	36W FLT 18Nos		648
140	Model Room 9307	36W FLT 14 Nos		504
141	Drawing Room 9308	36W FLT 34 Nos		1224
	Drawing Room 9304	36 W FLT 42 Nos		1512
OTHER BUILDINGS				
142	Ladies Hostel	36W FLT -37Nos	20W LED Tube -1 14W FLT-8 Nos.	1824
143	Guest House	36WFLT 78Nos	20W FLT 1No 36W PLl 3Nos	480
144	Health Center	36WFLT 1No		44
145	Security gate North	36WFRLT 1 No		44
146	Security gate South	36WFLT 3Nos		132
147	Boys Hostel (4 storie)	36W FLT 100Nos		4400
148	Workshop 1 Lab 37	36WTUBE 10Nos		440
149	Workshop LAB 2 4001	36W FLT 11Nos		484

150	Boundary Lighting	400W MH-6 Nos		2400
			TOTAL	**112369 Watt** **112.37 kW**

iii. Illumination Levels:

The illumination levels at different places were measured during the study period by using Lux meter and at that time total power consumption of the buildingswere measured. Lux levels measurement is given in the table below.Normally, after 4-5 pm there is no class or office work. In many places lighting is also needed in the day time. Lux level as measured is given bellow-

Table 13

SL. NO.	LOCATION	TOTAL CIRCUIT WATTS (W)	COVERED FLOOR AREA (m^2)	AVERAGE MEASURED ILLUMINATION (LUX)	RECOMMENDED (MIN-AVG-MAX) ILLUMINATION (LUX)	INDEX WATT / M^2	REMARK
1	**Mech. Engg 1st Year Room No.6021**	**352**	68.6	162	100-150-200	5.1	Ok to be replaced by LED Lamp
2	**Computer Lab-03 Room NO.6113**	**264**	70.699	96	100-150-200	3.7	Low Illumination to be replaced by LED Lamp
3	**Electrical. Engg 1St Year Room NO.6120**	**352**	68.6	124	100-150-200	5.1	Ok to be replaced by LED Lamp
4	**Common Room 6119**	**352**	68.6	124	100-150-200	5.1	Ok to be replaced by

							LED Lamp
5	**Faculty Room CSE 6109,6110,6111**	**354**	43.32	200	100-150-200	8.2	OK
6	**Lab-21 Room No. 6101**	**972**	97.97	319	100-150-200	9.9	Ok to be replaced by LED Lamp
7	**Canteen**	**212**	78.75	180	100-150-200	2.7	Ok to be replaced by LED Lamp
8	**Kitchen Area**	**80**	45.5	148	100-150-200	1.8	OK
9	**Dining Place beside kitchen**	**104**	72	136	100-150-200	1.4	OK
10	**6102 Lab - 20**	528	73.9	226	200-300-500	7.1	Ok to be replaced by LED Lamp
11	**LAB-2(Computer lab) 6112**	144	70.2	56	100-150-200	2.1	Low illumination, to be replace by LED lamp
12	**6103 LAB Electrical**	704	91.0	218	200-300-500	7.7	Ok to be replaced by LEE Lamp
13	**6104 Electrical Lab**	528	88.2	155	200-300-500	6.0	Low illumination, to be replace by LED lamp
14	**6106 Electrical Lab**	576	98.0	251	200-300-500	5.9	Ok to be replaced by LED Lamp

15	**6107 Seminar Hall**	2376	148.0	413	100-150-200	16.1	Ok Luminaries May be reduced
16	**6117 Call Centre**	304	48.5	259	100-150-200	6.3	OK Luminaries may be reduced
17	**CSE 1ST YEAR 6118 1ST Floor**	528	73.0	204	100-150-200	7.2	Ok to be replaced by LED Lamp
18	**CSE 4TH YEAR 6223**	756	166.6	281	100-150-200	4.5	Ok to be replaced by LED Lamp
19	**Mech. Engg. 4th year 6222**	756	205.6	256	100-150-200	3.7	Ok to be replaced by LED Lamp
20	**Laboratory Main**	720	445.3	201	200-300-500	1.6	Ok to be replaced by LED Lamp
21	**Library outside**	432	445.3	171	100-150-200	1.0	Ok to be replaced by LED Lamp
22	**Electrical 4th year 6219**	648	169.1	201	100-150-200	3.8	Ok to be replaced by LED Lamp
23	**LAB 30 6215**	432	240.7	190	200-300-500	1.8	Ok to be replaced by LED Lamp
24	**1st Floor Lab 29**	648	186.6	299	200-300-500		Ok

	6218 Digital electronics						to be replaced by LED Lamp
25	**LAB 28 6217**	540	66.6	271	200-300-500	8.1	Ok to be replaced by LED Lamp
26	**Faculty Room CE 6211,6212,6213**	216	41.6	115	100-150-200	5.2	Ok to be replaced by LED Lamp
27	**Class Room 6201**	864	149.9	108	100-150-200	5.8	Ok to be replaced by LED Lamp
28	**LAB 22 6202**	648	74.0	237	200-300-500	8.8	Ok
29	**LAB 23 6214**	432	163.6	249	200-300-500	2.6	Ok to be replaced by LED Lamp
30	**LABE 6203**	1728	184.3	242	200-300-500	9.4	Ok
31	**1st Floor Civil Eng. 4th floor 6204**	972	245.0	291	100-150-200	4.0	OK
32	**Faculty Room EE 6206 TO 6208**	540	46.1	124	100-150-200	11.7	Ok
33	**Computer Hal-4 6209**	864	96.0	108	100-150-200	9.0	High Power Density have a scope of savings by lowering wattage
34	**Drawing Hall 6210**	1296	123.0	280	200-300-500	10.5	High Power Density have a scope of savings by

							lowering wattage
35	**Computer Hall 6116**	648	71.3	279	100-150-200	9.1	OK
36	**Stat Lab**	972	83.6	276	200-300-500	11.6	High Power Density have a scope of savings by lowering wattage
37	**3rd Floor Civil ENGG 3RD YEAR 6329**	792	189.3	199	100-150-200	4.2	OK
38	**Class Room Electronics 6326**	432	172.9	250	100-150-200	2.5	Ok to be replaced by LED Lamp
39	**Research Room 6328**	528	208.7	242	200-300-500	2.5	Ok to be replaced by LED Lamp
40	**LAB-2 6319**	528	65.4	280	200-300-500	8.1	OK
41	**G Y M-1 6323**	288	33.1	303	100-150-200	8.7	OK
42	**GYM-26324**	288	32.4	303	100-150-200	8.9	High Power Density have a scope of savings by lowering wattage
43	**Faculty Room 6312,6313,1314**	288	58.4	115	100-150-200	4.9	Ok to be replaced by LED Lamp
44	**2nd FLOOR Seminar Hall 6301**	864	415.7	218	100-150-200	2.1	Ok to be replaced by

							LED Lamp
45	**Lab 39 6302**	528	209.3	211	200-300-500	2.5	Ok to be replaced by LED Lamp
46	**Corridor Lighting**	1496		169	50-75-100		Ok to be replaced by LED Lamp
47	**Computer Lab-5, 6315**	388	79.7	169	100-150-200	4.9	Ok to be replaced by LED Lamp
48	**Civil Eng. 2nd year 6303**	528	72.0	193	100-150-200	7.3	Ok to be replaced by LED Lamp
49	**Mech. Engg. 2nd year 6304**	720	99.0	281	100-150-200	7.3	Ok to be replaced by LED Lamp
50	**Faculty Room 6306,6307,6308**	360	48.0	156	100-150-200	7.5	Ok to be replaced by LED Lamp
51	**2nd Floor I Q A C 6317**	216	40.0	348	200-300-500	5.4	Ok to be replaced by LED Lamp
52	**Class Room 6309**	288	70.0	233	100-150-200	4.1	Ok to be replaced by LED Lamp
53	**Elec. Engg. 2nd year 6310**	264	61.0	217	100-150-200	4.3	Ok to be replaced by LED Lamp

54	**Geology 6311**	792	79.0	228	100-150-200	10.0	Ok High Power Densityto be replaced by LED Lamp
55	**Ground Floor, Tutorial Room 6124**	352	52.0	128	100-150-200	6.8	Ok to be replaced by LED Lamp
56	**Ground Floor Corridor**	1244			50-75-100		Ok to be replaced by LED Lamp
57	**Ground Floor Office 6115**	264	100.0	258	50-75-100	2.6	Ok to be replaced by LED Lamp
58	**1st Floor Corridor**	1512			50-75-100		Ok to be replaced by LED Lamp
59	**Server Room 1st Floor**	287	27.2	274	50-75-100	10.6	Ok High power density, lamp may be reduced
60	**BASEMENT LAB 10 6008**	80	68.1	77	100-150-200	1.2	Ok to be replaced by LED Lamp
61	**Lab 11 6009**	172	67.9	124	200-300-500	2.5	Ok to be replaced by LED Lamp
62	**LAB 12 6010**	180	70.7	70	200-300-500	2.5	Ok to be replaced by

							LED Lamp
63	**Store 6017**	144	25.0	91	50-75-100	5.8	Ok to be replaced by LED Lamp
64	**Lab -13 6411**	432	90.2	92	200-300-500	4.8	Ok to be replaced by LED Lamp
65	**Basement Corridor**	1232			50-75-100		Ok to be replaced by LED Lamp
66	**Addl. Workshop-4 6015 & 6016**	704	166.0	71	100-150-200	4.2	Ok to be replaced by LED Lamp
67	**Addl. Workshop -3 6014**	616	194.0	80	100-150-200	3.2	Ok to be replaced by LED Lamp
68	**Lab -5 6013**	792	151.1	112	200-300-500	5.2	Ok to be replaced by LED Lamp
69	**Lab 6002**	264	89.4	75	200-300-500	3.0	Ok to be replaced by LED Lamp
70	**Lab -7 6001**	440	77.2	90	200-300-500	5.7	Ok to be replaced by LED Lamp
71	**Lab -1 6007**	352	26.0	96	200-300-500	13.5	Ok to be replaced by LED Lamp

72	**Lab -1 6005**	528	197.3	72	200-300-500	2.7	Ok to be replaced by LED Lamp
73	**Ground Floor Principal Room**	148	37.1	149	100-150-200	4.0	Ok to be replaced by LED Lamp
74	**Ladies Hostel**	1824		141	100-150-200		Ok to be replaced by LED Lamp
75	**Guest House**	480		101	100-150-200		Ok to be replaced by LED Lamp
76	**Health Center**	44			100-150-200		Ok to be replaced by LED Lamp
77	**Security gate North**	44			100-150-200		Ok to be replaced by LED Lamp
78	**Security gate South**	132			100-150-200		Ok to be replaced by LED Lamp
79	**Boys Hostel (4 storie)**	4400			50-75-100		Ok to be replaced by LED Lamp
80	**Workshop 1 Lab 37**	440	78.8	40	200-300-500	5.6	Ok to be replaced by LED Lamp
81	**Workshop LAB 2**	484	159.3	47	200-300-500	3.0	Ok

	4001						to be replaced by LED Lamp
82	**3rd Floor Gym. Room 6423**	528	67.6	202	50-75-100	7.8	Ok to be replaced by LED Lamp
83	**Room 6422**	264	34.3	178	50-75-100	7.7	Ok to be replaced by LED Lamp
84	**Room No- 6421**	352	37.1	170	50-75-100	9.5	Ok to be replaced by LED Lamp
85	**Room No 6413**	352	66.1	172	50-75-100	5.3	Ok to be replaced by LED Lamp
86	**Room No 6414**	264	62.3	163	50-75-100	4.2	Ok to be replaced by LED Lamp
87	**Room No 6415**	1408	185.7	121	50-75-100	7.6	Ok to be replaced by LED Lamp
88	**Room No 6419**	352	69.3	128	50-75-100	5.1	Ok to be replaced by LED Lamp
89	**Room No 6418**	528	69.3	186	50-75-100	7.6	Ok to be replaced by LED Lamp
90	**Room No 6411**	352	86.6	179	50-75-100	4.1	Ok to be

							replaced by LED Lamp
91	**Room No 6417**	528	68.6	198	50-75-100	7.7	Ok to be replaced by LED Lamp
92	**Room No 6416**	528	67.9	211	50-75-100	7.8	Ok to be replaced by LED Lamp
93	**Faculty Room 6407,6408,6409**	440	56.4	207	50-75-100	7.8	Ok to be replaced by LED Lamp
94	**Room No 6401**	880	147.0	122	50-75-100	6.0	Ok to be replaced by LED Lamp
95	**Room No 6402**	1056	148.0	125	50-75-100	7.1	Ok to be replaced by LED Lamp
96	**Room No 6410**	704	81.2	115	50-75-100	8.7	Ok to be replaced by LED Lamp
97	**Room No 6403**	528	98.0	121	50-75-100	5.4	Ok to be replaced by LED Lamp
98	**Room No 6412**	352	71.9	128	50-75-100	4.9	Ok to be replaced by LED Lamp
99	**Room No 6405**	1056	148.0	117	50-75-100	7.1	Ok to be replaced by

							LED Lamp
100	**Room**	968	148.0	121	50-75-100	6.5	Ok to be replaced by LED Lamp
101	**ARCHITECTURETUREL BILDING Ground Floor Common Passage**	836					Ok to be replaced by LED Lamp
102	**M R- 1**	360	82.5	151	50-75-100	4.4	Ok to be replaced by LED Lamp
103	**M R - 2**	80	23.0		50-75-100	3.5	Ok to be replaced by LED Lamp
104	**M R - 3**	200	38.6	196	50-75-100	5.2	Ok to be replaced by LED Lamp
105	**Seminar Hall**	2096	219.8	149	100-150-200	9.5	High Power Density have a scope of savings by lowering wattage
106	**A R Workshop**	480	132.2	183	100-150-200		High Power Density have a scope of savings by lowering wattage
107	**Architecture Building 1st Floor Office Room 9109**	528	102.5	176	100-150-200		High Power Density have a

							scope of savings by lowering wattage
108	**Library & Reading Room 9110**	1848	185.8	133	100-150-200		High Power Density have a scope of savings by lowering wattage
109	**HOD Office**	616	149.6	174	100-150-200	4.1	High Power Density have a scope of savings by lowering wattage
110	**HOD Office**	200	38.7		100-150-200		High Power Density have a scope of savings by lowering wattage
111	**Corridor 1st Floor**	574			50-75-100		Ok to be replaced by LED Lamp
112	**Wash Room**	468			50-75-100		Ok to be replaced by LED Lamp
113	**Faculty Room**	244	71.4	117	100-150-200		High Power Density have a scope of savings by lowering wattage

114	**Class Room 9101**	968	232.4	126	100-150-200		Ok to be replaced by LED Lamp
115	**Class Room 9102**	1496	376.1	98	100-150-200		Ok to be replaced by LED Lamp
116	**Class Room 9105**	792	183.7	150	100-150-200		Ok to be replaced by LED Lamp
117	**Faculty Room9106**	352	30.0	97	100-150-200		Ok to be replaced by LED Lamp
118	**Class Room 9107**	1496	128.9	114	100-150-200		Ok to be replaced by LED Lamp
119	**Class Room 9103**	2640	86.1	133	100-150-200		Ok to be replaced by LED Lamp
120	**Architecture Building 2nd Floor Class Room 9205**	176			100-150-200		Ok to be replaced by LED Lamp
121	**Class Room 9203**	1848	146.6		100-150-200		Ok to be replaced by LED Lamp
122	**Class Room 9208**	1936	121.5		100-150-200		Ok to be replaced by LED Lamp
123	**Class Room 2 9207**	1936	121.9		100-150-200		Ok

							to be replaced by LED Lamp
124	**Class Room 3 9202**	1848	136.3		100-150-200		Ok to be replaced by LED Lamp
125	**Lobby**	588			200-300-500		Ok to be replaced by LED Lamp
126	**LAB - 2 9201**	1232	228.3		200-300-500		Ok to be replaced by LED Lamp
127	**Faculty Room**	528	29.9		50-75-100		Ok to be replaced by LED Lamp
128	**Faculty Room 9205**	352	15.8		50-75-100		Ok to be replaced by LED Lamp
129	**Faculty Room 9206**	528	39.7		50-75-100		Ok to be replaced by LED Lamp
130	**Class Room 9210**	2288	133.1		100-150-200		Ok to be replaced by LED Lamp
131	**Class Room -5 9210**	2464	298.7		100-150-200		Ok to be replaced by LED Lamp
132	**3rd Floor Hall**	616			50-75-100		Ok to be

							replaced by LED Lamp
133	**Toilet**	406			50-75-100		Ok to be replaced by LED Lamp
134	**Architecture Building 3Rd.Floor Mechanical House 9311**	2552	1402.2		100-150-200		Ok to be replaced by LED Lamp
135	**S - 9 9309**	1936	385.9		100-150-200		Ok to be replaced by LED Lamp
136	**Common Room 9305**	264	24.2		50-75-100		Ok to be replaced by LED Lamp
137	**Lab 9301**	648	61.1		200-300-500		High Power Density have a scope of savings by lowering wattage
138	**Lab 9302**	648	67.1		200-300-500		High Power Density have a scope of savings by lowering wattage
139	**Model Room 9306**	1008	209.4		100-150-200		Ok to be replaced by LED Lamp
140	**Model Room 9303**	648	676.5		100-150-200		Ok to be

							replaced by LED Lamp
141	**Model Room 9307**	504	24.0		100-150-200		Ok to be replaced by LED Lamp
142	**Drawing Room 9308**	1224	77.0		100-150-200		Ok to be replaced by LED Lamp
143	**Drawing Room 9304**	1512	96.0		100-150-200		Ok to be replaced by LED Lamp

Note: Recommended Lux is given as per Recommendation of IES (Illuminating Engineering Society).

General Observation:

I. Lux level mostly on higher side

II. The remarks on lux level is given in the relevant column.

Recommendation:

I. There is scope of reduction of illumination level and there by reduction in energy consumption as well.

II. To keep the same lux level replace all 36 watt and 40 watt tube light by 20watt energy efficient LED Tube light.

III. To keep the same lux level replaces all 36watt PL lamp by 20 watt LED PL.

Chapter 9

Misc.

Other Details of the Building Load

Table 14

Sl. No.	Location	Fan Load	No.	Unit Wattage	Fan Wattage	Computer/Printer/Other	No.	Unit Watt	Computer etc. Watt
1	Mechanical Workshop	Ceiling + Exhaust	2+2	80+250	660	-	-	-	-
2	Thermal Workshop	Ceiling + Exhaust +Wall	1+4+ 1	80+250+45	375	-	-	-	-
3	Additional Workshop Room No. 6015 & 6016	Ceiling + Exhaust +Wall	2+4+ 1	80+250+46	590	PC LCD type Printer	1 1	120 150	270
4	CNC Laboratoy-12 Room no. 6010	Ceiling +Wall	2+1	80+45	205	PC LCD type	1	120	120
5	Class Room No. 6120	Ceiling	6	80	480	-	-	-	-
6	Faculty Room Room No.6109,6110,6111	Wall Fan Exhaust	10+1	45+60	510	-	-	-	-
7	Lab-21 Room NO.6101	Ceiling	8	80	640	-	-	-	-
8	Lab-20 Room NO.6102	Ceiling Exhaust	9+1	80+60	780	-	-	-	-
9	Lab-17 Room NO.6103	Ceiling	8	80	640	-	-	-	-
10	Lab-16 Room NO.6104	Ceiling	7	80	560	-	-	-	-
11	Lab-14 Room NO.6106	Ceiling Exhaust	6+2	80+60	540	-	-	-	-

12	Server Room								
13	Seminar Hall 6107					Projector	1	300	120
14	Language Lab	Ceiling Wall	6+3	80+45	615	-	-	-	-
15	Civil 1st Year Room No. 6118	Ceiling	6	80	480	-	-	-	-
16	Computer Stat Lab Room NO.6116	-	-	-	-	LCD Type+ Printer	29+ 1	120+25	3565
17	Computer Lab Room NO.6116	-	-	-	-	Projector	1	300	120
18	Principal Room	Ceiling	2	80	160	LCD +Printer (laser)	1+1	120+250	970
19	Computer Lab-2 Lab 18					LCD Type	30	120	3600
20	Computer Lab-2 Lab 19	Wall Fan	1	45	45	LCD +Printer (laser)	30+ 1	120+250	4450
21	Office No.-1	-	-	-	-	LCD Type Scanner Printer Xerox	5 2 1	120 150 750	2100
22	Office Store	-	-	-	-				
23	Deputy Register	-	-	-	-	LCD Type Cannon Printer	1 1	120 80	200
24	Secretary Room	Wall Fan	1	45	45	LCD Type	1	120	120
25	Vice Principal	-	-	-	-	LCD Type Laser Printer	1 1	120 250	970
26	Room No,6125	-	-	-	-	LCD Type Scanner Printer	1 1 1	120 80 80	280
	3RD Floor								
27	Room No,6415	Ceiling fan	7	80	560	-	-	-	-
28	Room No,6414	Ceiling fan	2	80	160	-	-	-	-

30	Room No.6423	Ceiling fan	12	80	960	-	-	-	-
31	Room No.6412	Ceiling fan	3	80	240	-	-	-	-
32	Room No.6406	Ceiling fan	9	80	720	-	-	-	-
33	Lab-35 Room No. 6315	Ceiling fan	6	80	480	-	-	-	-
34	Class Room No. 6303	Ceiling fan	6	80	480	-	-	-	-
35	Class Room No. 6304	Ceiling fan	9	80	720	-	-	-	-
36	Room No. 6421	Ceiling fan	6	80	480	-	-	-	-
37	Ladies Toilet (Third Floor)	Exhaust (small)	1	60	60	-	-	-	-
38	R & D Cell (ECE) 6419	Ceiling fan	7	80	560	-	-	-	-
39	R & D Cell (E) 6411	Ceiling fan	5	80	400	-	-	-	-
40	R & D Cell (CSE) 6418 (less use)	Ceiling fan	6	80	480	-	-	-	-
41	Room No.6417	Ceiling fan	6	80	480	-	-	-	-
42	Room No.6416	Ceiling fan	6	80	480	-	-	-	-
43	Faculty Room (3rd Floor) Room No.6407, 6408, 6409 (less use)	Ceiling fan	4	80	320	-	-	-	-
44	Rom No. 6401 (Less Use)	Ceiling fan	9	80	720	-	-	-	-
45	Rom No. 6402 (Less Use)	Ceiling fan	9	80	720	-	-	-	-
46	Store Room (3rd Floor)	Ceiling fan	6	80	480	-	-	-	-

47	Girls Indoor Room Room No. 6403	Ceiling fan	6	80	480	-	-	-	-
48	Boys Toilet	Ceiling fan	1	80	80	-	-	-	-
49	Faculty Room (2nd Floor)	Ceiling fan	4	80	320	LCD Type	2	120	240
50	Computer Science Engineering (2nd Floor) 2nd Year	Ceiling fan	6	80	480	-	-	-	-
51	Lab 33 (2nd Floor) Room No. 6318	Ceiling fan	1	80	80	-	-	-	-
52	Electronics & Telecommunication (2nd Floor) 2nd Year	Ceiling fan	5	80	400	-	-	-	-
53	Lab 32 (2nd Floor) Room No. 6311	Ceiling fan	5	80	400	PC LCD Type	1	120	120
54	Chair, Table Store Room 2nd Floor (No use) 6321	Ceiling fan	6	80	480	-	-	-	-
55	Middle Corridor 2nd Floor Beside Room 31	Ceiling fan		80	0	-	-	-	-
56	Civil 3rd year Room No. 6329 (2nd Floor)	Ceiling fan	6	80	480	-	-	-	-
57	Lab-30 (2nd Floor) 6320 (Less Use)	Ceiling fan	4	80	320	-	-	-	-
58	Lab-38 (2nd Floor) 6328 (Less Use)	Ceiling fan	6	80	480	-	-	-	-
59	Girls Toilet (2nd Floor) Room No. 6327	Ceiling fan		80	0	-	-	-	-
60	Tutorial 2nd Floor (6319) (Less)	Ceiling fan	4	80	320	-	-	-	-
61	Electronics & Telecommunication (2nd Floor) 3rd Year	Ceiling fan	6	80	480	-	-	-	-

62	Computer Science Engineering (2nd Floor) 3rd Year	Ceiling fan	6	80	480	-	-	-	-
63	MEC 3rd Year (3nd Floor)	Ceiling fan	6	80	480	-	-	-	-
64	Boys Toilet (1st Floor)	Ceiling fan		80	0	-	-	-	-
65	Faculty Room (1st Floor) 6206, 6207, 6208	Ceiling fan	7	80	560	-	-	-	-
66	Lab-25, 6209 (1st Floor)	Ceiling fan	9	80	720	PC LCD	18	120	2160
67	Drawing Hall 6210. (1st Floor)	Ceiling + Wall	9+1	80+45		-	-	-	-
68	Stair Case (Open Type) 1st Floor Corridor	Ceiling fan		80	0	-	-	-	-
69	Lab 26 1st Floor (6215)	Ceiling fan	4	80	320	-	-	-	-
70	Faculty Room Floor 1st floor 6211, 6212, 6213	Ceiling fan	4	80	320	-	-	-	-
71	Lab-28 6217	Ceiling fan	6	80	480	-	-	-	-
72	Lab 27, 6218	Ceiling fan	6	80	480	-	-	-	-
73	Class Room No. 6219	Ceiling fan	6	80	480	-	-	-	-
74	Boys Indoor Room No. 6220	Ceiling fan	5	80	400	-	-	-	-
75	Computer Science 4th Year 1st Floor 6223	Ceiling fan	6	80	480	-	-	-	-
76	MCC Engg. 4th Year & 1St Year 6222	Ceiling fan	6	80	480	-	-	-	-
77	Library 1St Floor 2	Wall	10	45	450	PC LCD	10	120	1200

	Room (Digital Lab)	Fan				type			
78	Library Room -1	Pedestal + Wall	1+2	100+45	190	PC LCD type	5	120	600
79	In front of lift 1st floor.					-	-	-	-
80	Room No. 6323 (2nd Floor)	Ceiling fan	2	80	160	-	-	-	-
81	Gym Room No. 6322(2nd Floor)	Ceiling fan	2	80	160	-	-	-	-
82	Faculty Room 2nd Floor 6312, 6313, 6314	Pedestal + Wall	3+3	100+45	435	PC LCD type	3	120	360
83	Seminar Room 6201	Ceiling fan	12	80	960	-	-	-	-
84	Lab 22 (1st Floor) 6202	Ceiling fan	5	80	400	-	-	-	-
85	Lab 23 (1st Floor) 6214	Ceiling fan	4	80	320	PC LCD type	1	120	120
86	Civil Engg. 4th Year (1st floor)	Ceiling fan	9	80	720	-	-	-	-
87	Lab-24 (1st floor)	Ceiling fan	4	80	320	-	-	-	-
88	Lift Room (Motor Room)	Exhaust (small)	2	100	200	-	-	-	-
89	Lift (2 nos total)	small Fan	4	40	160	-	-	-	-
90	Boys Hostel	Ceiling Fan Ceiling Fan	32+16	80+60	3520	TV 24" Water Purifier	1 1	120 35	155
91	Girls Hostel	Ceiling Fan	29	80	2320	TV 36" Water Purifier	1 1	150 35	185
92	Placement Office	Ceiling Fan	3	80	240	-	-	-	-
93	Canteen	Ceiling Fan Exhaust	5 1	80 120	520	-	-	-	-

	Total				**37620**				**22025**
	Total kW				37.62				22.03

Remark: 5Nos of solar water heating system has been use 2nos. of 500 LPD capacity in Boys Hostel, 2 Nos. of 500 LPD in Girls Hostel and 1 for canteen of capacity 500LPD.

A. Copy machine and Printers

- **Make sure that all the machines and printers are turned off at night and over weekends. Sleeping mode of the Copy Machine should be avoided, as far as practicable.**

Turn copiers and printers off at night and on weekends. Even in the "sleep mode" these devices burn 100 watts of electricity. Instead of relying on the last one to leave the office, doing other jobs, turn it off, consider installing a low cost plug in 7day timer that can be easily overridden to automatically shut off copy machine at night and on weekends.Even when the machine is not in operation, it should be kept off.

Do not keep copier machine in sleeping mode when not in use. Details of saving calculation is in table 19

B. Activate Power Management features

For copy machines, refer to the User's Manual or ask your service technician to determine if the Power Management features are enabled. The User's Manual should provide the necessary instructions. Check the period of delay for activating energy saver mode or automatic shutoff.

For printers, refer to the User's manual or ask your service technician to check if your printer's Power Management features are enabled.

C. Purchase/Use of Ink Jet Printers in place of Laser Printer

If it works for your business or work group, consider Ink Jet printers, which use 90% less energy than Laser printers. **Details saving calculation in table 18.**

D. Use of Alternative Power Source

a) Action toward utilization of solar energy has already been taken by installing Solar Street Light.

b) Solar water heating system has been installed in hostels and canteen.

c) There is huge scope of solar power generation on the roof top of the college and hostel buildings.

- **On the roof top of the Maim College Building about 100 kw of solar power generation is possible.**
- **In Architect Building Rooftop there are capacity of 75 kW Solar power plant.**

Table 15

Main Building

Particulars	Unit	Details
Main Building Roof Top Area	Sq.m	1350
Implementation Area available	Sq.m	1080.00
Area occupied by a solar cell	Sq.m	1.50
Watt peak capacity of a single cell	Watt	230.00
Proposed Capacity of the Solar Power Plant	kW	100.00
Controller Efficiency	%	90
Mismatch Factor	%	85
Array Load	kW	111.11
Array Size	Watt peak	130.72

Requirement of 230 Watt peak Module	Nos.	568
Area Requirement @ 3 m2 / module including maintenance place	m2	1023

Table 16

Architecture Building

Particulars	**Unit**	**Details**
Architecture Building Roof Top Area	Sq.m	962
Implementation Area available	Sq.m	769.60
Area occupied by a solar cell	Sq.m	1.50
Watt peak capacity of a single cell	Watt	230.00
Proposed Capacity of the Solar Power Plant	kW	75.00
Controller Efficiency	%	90
Mismatch Factor	%	85
Array Load	kW	83.33
Array Size	Watt peak	98.04
Requirement of 230 Watt peak Module	Nos.	426
Area Requirement @ 3 m2 / module including maintenance place	m2	767

E. Repair the cold insulation of chilled water pipe on the rooftop of the college building.

During our survey of the college building rooftop it was found that the cold insulation of the (20mm dia.) chilled water pipeline approximately of 100 mtr.length is damaged. It is needed to be repaired without any further delay. Details calculation of loss is given in the energy savings calculation table.

Chapter 10

Energy Savings Proposal

ESM# 1utilize 20W energy efficient LED Tube light by replacing T 36.

Table 17

	COMPARISION BETWEEN TL-D 36W AND T8 LAMP SYSTEM WITH 19W LED TUBE		
Sl. No.	**Parameter**	**1 x TLD 36W**	**1 x 19w LED TUBE**
1	Lamp Wattage	36	19
2	System Wattage	40	19
3	Ballast Type	Electronic	Not Required
4	Quantity (Considered for Same Lux Levels)	150	150
6	**Total system load KW**	6	2.85
7	Usage hr.per day	**4**	**4**
8	Usage day per year	155	155
9	Total energy consumed (Units) Yrly.	3720	1767
10	Energy Cost per unit (Rs)	10.35	10.35
11	Lamp Life (Br. Hrs.)	5000	40000
12	Lamp Unit Price	40	0
13	Total Lamp Replacement Cost Yearly (Rs)	**744**	**0**
14	Total Ballast Replacement Cost (Rs)	**16500**	

14	Total Energy Cost (Rs) Yearly	**38502**	**18288.45**
15	Savings in Yearly Energy Cost (Rs)		**20213.55**
16	Saving in Lamp & Ballast Replacement Cost		**17244**
17	**TOTAL YEARLY SAVINGS (Rs)**		**37457.55**
18	Cost Per System (Rs)	150	500
19	Initial Investment (Rs)		75000
20	Extra Cost (Rs)		75000
21	**Pay Back Period**	**Month**	**24.0**

ESM# 2 utilize 19W energy efficient LED Tube light by replacing T40.

Table 18

	COMPARISION BETWEEN TL-D 40W LAMP SYSTEM WITH 19W LED TUBE		
Sl. No.	**Parameter**	**1 x TLD 40W**	**1 x 19w LED TUBE**
1	Lamp Wattage	40	19
2	System Wattage	44	19
3	Ballast Type	Electronic	Not Required
4	Quantity (Considered for Same Lux Levels)	100	100
6	**Total system load KW**	4.4	1.9
7	Usage hr.per day	4	4
8	Usage day per year	155	155
9	Total energy consumed (Units) Yrly.Kwh	2728	1178
10	Energy Cost per unit (Rs)	10.35	10.35
11	Lamp Life (Br. Hrs.)	5000	40000

12	Lamp Unit Price	40	0
13	Total Lamp Replacement Cost Yearly (Rs)	**496**	**0**
14	Total Ballast Replacement Cost (Rs)	**11000**	
14	Total Energy Cost (Rs) Yearly	**28234.8**	**12192.3**
15	Savings in Yearly Energy Cost (Rs)		**16042.5**
16	Saving in Lamp & Ballast Replacement Cost		**11496**
17	**TOTAL YEARLY SAVINGS (Rs)**		**27538.5**
18	Cost Per System (Rs)	150	500
19	Initial Investment (Rs)		50000
20	Extra Cost (Rs)		50000
21	**Pay Back Period**	**Month**	**22**

ESM# 3 Do not keep copier machine in sleeping mode when not in use

Table 19

Description	Quantity	Unit
Power consumption of copy machine in non operating mode (sleeping mode)	100	watt
Sleepy Mode of Copy M/c	3	hrs/day
Energy Savings for Approximate Sleepy Mode Hours for 2 hours/day	300	watt/day
No. of working days/yr. for copy m/c	268	days/yr.
Total Savings in the year	80400	watthr/Yr.
	80.4	kwh/yr.
Rate of Energy Cost	10.35	Rs./khw
Annual Energy Cost Saving	832.14	Rs/yr.
Investment	0	
Payback period	**Immediate**	

ESM#4Purchase/Use of Ink Jet Printers in place of Laser Printer

Table 20

Description	Quantity	Unit
Energy Cost for Using Laser Printer		
Number of printers to be replaced	5	Nos.
Po wer Consumption by Ink jet Printer	150	watt/machine
Power Consumption by Laser Printer	750	watt
Normal operating hours	7	hrs
Energy consumed/day	5250	watt.hr.
	5.25	kwh/day
Energy Cost	10.35	Rs./unit
Working Days	268	days/yr.
Total Energy Cost/yr	14562.45	Rs./yr.
Energy Cost for Using Ink jet Printer		
Number of printers to be replaced	5	Nos.
Power Consumption by inkjet Printer	80	watt/machine
Power Consumption by Laser Printer	400	watt
Normal operating hours	7	hrs
Energy consumed/day	2800	watt.hr.
	2.8	kwh/day
Energy Cost	10.35	Rs./unit
Working Days	268	days/yr.
Total Energy Cost/yr	7766.64	Rs./yr.

Total Savings Using Inject Printer In place of Laser Printer	6795.81	Rs./yr.
Cost Involvement/Machine	6000	Rs
Replacement Cost	1000	RS
Total cost involvement	25000	RS
Pay Back Period	**44**	**Month**

ESM#5 Repair of Damaged Insulation of Chilled Water line on college Building Roof Top

Table 21

Description	Unit	Quantity
Dia of Pipe	mm	20
Length of pipe	m	100
Bare pipe outer dia	m	0.022
Bare pipe surface area	m2	6.908
Ambient Temperature	0C	30
Bare Pipe Wall temperature	0C	16
Desired wall Temperature with insulation	0C	26
Existing Heat gain	kcal/hr-m2	-130.2
Modified System		
Modified heat gain	kcal/hr-m2	-39.2
Heat Gain	kcal/hr-m2	91
Total Heat Gain from Bare Pipe	kcal/hr	628.628
Capacity of Chiller	kcal/hr	3024
Power Consumption	kW/TR	5.54
Power Loss due to heat gain	kW	1.151653
Operating Hours	hrs.	5

No. of days	Days	247
Total Energy Loss/yr.	kWh/yr.	1422.292
Cost of per unit	Rs./unit	10.35
Total Loss in a year	Rs.	14720.72
Cost involvement for Replacement	Rs.	4000
Payback period	**Month**	**3**

ESM#6Installation of VSD with each water supply pump will reduce the energy consumption

Table 22

Description	Units	Values	
Pump Details		Water Lifting Pump	Submersible Pump
Quantity	Nos.	1	1
Rated Motor Power	kW	4	5.5
AVG. Operating Power	kW	3.3	4.26
Daily operating hour	Hour	3	3
Yearly Operating Days (avg.)	Days	300	300
Energy consumption per annum	kWh	2970	3834
Savings of Energy (30%of the energy consumed)	kWh	891	1150.2
Average Energy Cost	Rs./kWh	10.35	10.35
Monitory Savings	LakhsRs.	0.09	0.12
Investment	LacsRs.	0.23	0.3
Payback Period	**Month**	**30**	**30**

ESM#7Replace old fan with energy efficient BEE star rated Fan

Table 23

List of existing Fan

Number of Fan in Operation	No.	Unit Wattage	Total Wattage
Main Building	402	80	**32160**
Architecture Building	261	80	**20880**
Hostel and other places	24	80	**1920**
Total	**687**		**54960**

Particulars	Unit	Value
No. of Fan in Operation	no.	687
No. of Fan Suggested to replace Running Hour More than 6 hour	No.	300
Wattage of Existing Fan	Watt	80
Wattage of Energy Efficient Fan	Watt	53
Savings of Power Per Fan	Watt	27
Total Savings in Power	Watt	8100
Total Savings in Power	kW	8.1
Working Hour Per Day	Hour	8
Annual Working Days	Days	210
Annual Working Hours	Hours	1680
Savings of Electrical Energy	kWh	13608
Savings of Money @12.21 Per Unit	Rs.	166153

Investment @ Rs.1500/Fan	Rs.	450000
Pay Back Period	Month	33

THE END