Report

On

ENERGY AND GREEN AUDIT

For

BLDE (Deemed to be University)
Viyayapura 586 103

Prepared

By

Senergy Consultants Pvt Ltd
Mumbai

March 2020

Helping You to Conserve Energy

Contents

Chapter - I
Introduction

Energy and Green Audit was undertaken at BLDE (Deemed to be University), Shri B M Patil Medical College, Hospital and Research Centre, Smt. Bangaramma Sajjan Campus, Dr B M Patil Road, Vijayapura 586 103 Karnataka, during the month of March 2020.

The organization is very keen to promote green culture wherever possible, as a commitment towards better environment and conservation of energy. To further optimize consumption and identify saving opportunities, M/s Senergy Consultant Private Limited was assigned to carry out Green Audit of the premises.

This Audit Report presents the analysis of the data collected, observations made at the facility and is governed by the objectives, scope of work, methodology etc. discussed in the ensuing paragraphs.

Team:

Ravindra Datar – Director
B Tech – Chemical (1983): Indian Institute of Technology, Mumbai
Accredited & Certified Energy Auditor: Bureau of Energy Efficiency (B E E)
Lead Auditor (ISO 50001- 2011): Energy Management System

Publish over 50 articles and papers on conservation of energy in national & international journals and periodicals
Conducted over 150 training programs on conservation of energy for industries, educational institutes and others

Responsible to carry out over 1,500 Energy Audits & Energy Conservation Studies in various industries spread over India, African continent & United Arab Emirates, Thailand

Umesh Phatakare – Project Manager
B E – Mechanical (2013): Mumbai University
Certified Energy Manager: Bureau of Energy Efficiency (B E E)

Responsible to carry out over 200 Energy Audits & Energy Conservation Studies in various industries spread over India.

Sanket Mahadik – Project Manager
B E – Electrical (2012): Mumbai University

Responsible to carry out over 50 Energy Audits & Energy Conservation Studies in various industries spread over India.

Mr. Vishal Narsale (BE Electrical)-Project Engineer
B E – Electrical (2019): Mumbai University

Responsible to carry out over 5 Energy Audits & Energy Conservation Studies in various industries spread over India.

Instruments:

The following instruments were utilized for measurement during the energy audit study.

1. Power Analyzer
2. Hygro-temp meter
3. Vane Type Anemometer
4. Hot Wire Anemometer
5. Lux meter
6. Environmental meter
7. Measuring Tape

Acknowledgment:

We wish would express our gratitude towards Management of BLDE (Deemed to be University) for having given us the opportunity for conducting the study and the support provided during the study.

We are also thankful to the entire team for extending the necessary help and co-operation from their side.

Chapter - II
Executive Summary

The premises were evaluated against the various criterions laid down by the National Assessment and Accreditation Council (NAAC).

The major observations are

1. Greenery
    a. The campus is well covered with green trees; with are over 6500 individuals comprising of trees, shrubs & bushy ornamental plants belonging to 48 different species spanning across the entire area. The plantation of trees is an ongoing activity with additional planation has been initiated in the premises.

2. Alternate Source of Energy
    a. A lot of importance is given to alternative / renewable energy.
    b. The 240 kW of rooftop solar photovoltaic system is in operation; while further expansion is also being planned.
    c. The 3300 kW solar power plant has also been installed to supply green power to the grid.
    d. Solar water heating systems are provided for generating and meeting the hot water requirements in the campus.
    e. An initiative has been taken to install biogas plant in the premises.

3. Sewage Treatment Plant
    a. A 450 KLD capacity sewage treatment plant has been in operation to treat entire sewage generated in the campus. A major part of the treated water is recycled and used for gardening; the excess is discharge through Municipal system.

4. Water Purification Plant
    a. The water supplied by the Municipal Corporation is used for drinking After Purification
    b. A set of RO Water Purifier is provided at convenient locations.

5. Solar Energy
    a. A 240 kW of rooftop solar photovoltaic system is in operation; while further expansion is also being planned.
    b. A 3300 kW solar power plant has also been installed to supply green power to the grid.
    c. Solar water heating systems are provided for generating and meeting the hot water requirements in the campus.

6. Biogas Plant
    a. An initial study on feasibility of installing biogas plant from plate and canteen waste is been planned. This may be expediated and taken up for implementation.

7. Wheeling to the grid
    a. The 3300 kW solar power plant has also been installed to supply green power to the grid.
    b. The 240 kW of rooftop solar photovoltaic system may also be synchronizing with grid with net metering to maximize the generation.

8. Sensor Based Energy Conservation
    a. Energy efficient light fittings have been installed at some of the places. However, the possibility of sensor based energy conservation may be evaluated, especially for the street lights, lamps and fans operating in the common area and / or for a longer period.

9. Used of LED Bulbs/ Power efficient equipment
    a. Energy efficient light fittings have been installed at some of the places. However, the possibility of replacing the present light fitting with LED lamps and sensor based energy conservation may be evaluated, especially for lamps operating for a longer period or while making new purchases.
    b. Illumination level is more or less with in the norm and operational requirements.
    c. The fans & lights are switched off when not in use.
    d. Energy efficient computers and monitors have been procured and are switched off, when not in use.
    e. Energy efficient air conditioners with higher star rating have been procured during recent purchases. The older and lower star rating units may be progressively replaced with energy efficient units.
    f. The air conditioners are switched off, when not in use.
    g. The performance of the air conditioners was observed to satisfactory.
    h. The possibility of replacing the fans with high efficiency fans may be ascertained; especially while making new purchases.

10. Solid Waste Management
    a. The composting pit is provided for converting dry plant leaves and other waste in the manure.
    b. The awareness programs have been conducted for segregation and management of domestic solid waste; which may be introduced at an early date. The organic waste can be composted and converted in to manure, the other waste can be further segregated and put to productive usage. The existing composting pit may be used, if possible.
    c. An initial study on feasibility of installing biogas plant from plate and canteen waste is been planned. This may be expediated and taken up for implementation.
    d. The generation of waste is minimized through use of electronic communication.

11. Liquid Waste Management
    a. A 450 KLD capacity sewage treatment plant has been in operation to treat entire sewage generated in the campus. A major part of the treated water is recycled and used for gardening; the excess is discharge through Municipal system.
    b. A separate effluent treatment plant has been installed to treat the non-domestic waste water. A part of the treated water is recycled and used for gardening; the excess is discharge through Municipal system.

12. Biomedical Waste Management
    a. The biomedical waste is segregated in to three categories i.e. yellow, blue and red. The yellow category waste disposed of through an incinerator while the others are properly sterilized and disposed through the municipal system.

13. E- Waste Management
    a. All the electronic waste is segregated and recycled, if possible. The remaining waste is handed over to an E-waste Management Organization for proper disposal.

14. Waste Recycling System
    a. The sewage treatment plant has been in operation to treat entire sewage generated in the campus and a major part of the treated water is recycled and used for gardening.
    b. A part of the electronic waste is recycled as possible.

c. The composting pit is provided for converting dry plant leaves and other waste in the manure; which is sued for gardening.
d. The awareness programs have been conducted for segregation and management of domestic solid waste; which may be introduced at an early date. The organic waste can be composted and converted in to manure, the other waste can be further segregated and put to productive usage. The existing composting pit may be used, if possible.
e. An initial study on feasibility of installing biogas plant from plate and canteen waste is been planned. This may be expediated and taken up for implementation.

15. Hazardous Chemicals and Radioactive Waste
    a. The hazardous chemicals and radioactive waste are categorized as yellow category; while this has been disposed of through an incinerator before it gets properly sterilized.

16. Rain Water Harvesting:
    a. Construction of ponds and borewell/ open well recharge projects has been proposed in the premises by the management. These may be taken up for implementation.
    b. The yearly rain fall in the area like Vijayapura is very less, still the rain water harvesting projects with feasible economics may be implemented in near future; while rain water harvesting may be incorporated in new project at the development stage.

17. Borewell/ Open Well Recharge
    a. Borewell/ open well recharge projects have been proposed in the premises by the management.

18. Construction of tanks and bunds
    a. Construction of tanks and bunds projects has been proposed in the premises by the management.

19. Waste Water Recycling
    a. The sewage treatment plant has been in operation to treat entire sewage generated in the campus and a major part of the treated water is recycled and used for gardening.

20. Maintenance of water bodies and distribution system in the campus
    a. The main source of water for the campus is municipal water and other source is bore water which is used as per the requirement. The water is collected in to the main tank and then it is distributed to the respective building tank in the premises.
    b. The possibility of metering borewell water may also be assessed.

21. Restricted Entry of Automobile
    a. Automobile movement in the campus is regulated.
    b. The adequate parking space is available and car parking provisions are made for staff and student.

22. Battery Powered Vehicle
    a. There are total three E-(Battery Powered) Vehicles in the campus, one of which is dedicated for student and staff transportation, the others are used for the cargo transportation.

23. Pedestrian Friendly Pathways
    a. All the pathways in the premises are pedestrian friendly for movement.
    b. The movement on-campus is distributed with multiple entrances.

24. Ban on the use of plastics
    a. The usage of plastic has been regulated in the premises.

25. Landscaping with trees and plants
    a. The campus is well covered with green trees; with are over 6500 individuals comprising of trees, shrubs & bushy ornamental plants belonging to 48 different species spanning across the entire area. The plantation of trees is an ongoing activity with additional planation has been initiated in the premises.

26. Clean and green campus recognitions/ awards
    a. The ventilation is adequate, and the carbon dioxide as well as the Volatile Organic Matter contents are within a limit for all of the class rooms and other premises.
    b. The initiatives have been taken towards the clean and green campus.

27. Environmental Activities
    a. Waste management program, electrical safety and fire safety programs have been conducted throughout the academic year.
    b. Electronic communication is encouraged to minimize usage of papers.
    c. Most of the papers are reused for doubled sided printing.
    d. The promotion of trees plantation has been taken by the management.
    e. Use of plastics is regulated.
    f. Rainwater harvesting is being planned.

Potential Saving Area:

Major savings can be achieved by

- Replacing conventional lamps with LED Lamps.
- Replacing conventional fans with energy efficient fans with BLDS motors
- The 240 kW of rooftop solar photovoltaic system may also be synchronizing with grid with net metering to maximize the generation.

Chapter - III
Energy Consumption Pattern

Electricity Bill

The electricity for the entire premises is supplied by Hubli Electricity Supply Company Ltd High Tension (HT) connection. The details of energy consumption with costs are as under.

Description	Unit	Apr-19	Jun-19	July/ August/ September 19	Oct-19
Consumer No.: 6339993000		**Category : Commercial**			
Contract Demand : 720 KVA		**Tariff: HT2C1**			
Energy Consumption	kWh	266440	213240	676200	201840
	kVAh	282240	226851	719362	217735
Maximum Demand	kVA	643	652	720	720
Billed Demand	kVA	643	652	720	720
Power Factor (PF)		0.94	0.94	0.94	0.93
Average Consumption	kW	370	287	293	271
Load Factor	%	61.2%	46.8%	43.4%	40.6%
Demand Charges	Rs	135030	136920	151200	151200
Bill	Rs	2273463	1893386	5764732	1746065
Cost	Rs/kWh	8.5	8.9	8.5	8.7

Description	Unit	Nov-19	Dec-19	Jan-20	Average
Consumer No.: 6339993000		**Category : Commercial**			
Contract Demand : 720 KVA		**Tariff: HT2C1**			
Energy Consumption	kWh	194360	171600	186400	212231
	kVAh	209666	185113	201079	226894
Maximum Demand	kVA	720	720	720	
Billed Demand	kVA	720	720	720	
Power Factor (PF)		0.93	0.93	0.93	0.93
Average Consumption	kW	270	238	259	284
Load Factor	%	40.4%	35.7%	38.8%	44%
Demand Charges	Rs	151200	151200	151200	147817
Bill	Rs	1664035	1481773	1579787	1822582
Cost	Rs/kWh	8.6	8.6	8.5	8.6

The power cost is around Rs 8.6/- per kWh.

Contract Demand:

The billed demand is same as the contract demand, there are no major savings expected in this area.

Power Factor:

The power factor was observed to be around 0.93 for consumer no 6339993000. The penalty is slapped if the power factor drops below 0.90

There are no major savings expected in this area.

Solar Power consumption :

The details of solar power generation from solar photovoltaic system is as under,

The roof top solar photovoltaic system of 248 kW capacity has been commissioned from September 2019, where it is not wheel to the grid.

The details are as under,

Rooftop: 248 kW

Month	Power Generation	Specific Power
	kWh/Month	kWh/Day/kW_P
Sep-19	14064.0	1.9
Oct-19	19535.0	2.5
Dec-19	21182.0	2.8
Jan-20	25284.0	3.3

The specific power appears to be marginally lower than the typical values of 4.5 to 5 kWh/kW_P; which may be investigated and remedied.

Diesel Consumption:

The details of the diesel consumption are as under,

Month	Diesel Consumption	Cost
	Liters	Rs
Hospital		
Mar-19	2353	164871
Jul-19	4244	293982
Aug-19	5091	347175
Sep-19	2064	142981
Oct-19	6385	443014
Nov-19	2684	184609
Dec-19	6439	446879
College		
March -19 to Jan-20	1969	136223
Total	**31230**	**2159734**

Light fittings:

No	Location	TFL (MB)		LED	
		40 W	36 W	36W	18W
Central Library					
Ground Floor					
1	Post Graduate Section		22	6	
2	Under Graduate Section		22	23	
3	Library Entrance			3	
4	Library Cabin		3		
First Floor					
1	Reading Room			6	
Second Floor					
1	UG-Reading Hall 1		24		
2	PG-Reading Hall			12	
3	UG-Reading Hall 3			6	
Physiology					
Ground Floor					
1	Department Library Seminar Room	1	4		
2	Demonstration Room-1		3		
3	Assistant Professor	2	3		
4	Associate Professor-1		2		
5	Associate Professor-2		2		
6	Associate Professor-3		2		
7	Associate Professor-4		2		
8	Professor and HOD Cabin		4		
9	Demonstration Room-2	4	2		
10	Associate Professor-5	1			
11	Associate Professor-6		1		
12	Associate Professor-7		1		
13	Associate Professor-8	1			
14	Associate Professor-9		1		
15	Research Lab		6		
16	Human Clinical Lab		7		
17	Department Library Seminar Lab	2			
18	Demonstration Room-3	4	3		
19	Department Office		5		
20	Practical Class		16		
21	Laboratory Room				25
22	Associate Professor-10	2			
23	Associate Professor-11	2			
First Floor-Forensic Department					
1	Research Lab		2		
2	Department Library Seminar Room	3			
3	Edmund Lockard's Museum	8	1		
4	Hematology Lab	12			
5	Amphibian Lab	12			

No	Location	TFL (MB)		LED	
		40 W	36 W	36W	18W
Physiology					
First Floor-Forensic Department					
6	Mammalian Lab	1	1		
7	Department Office	2			
8	Assistant HOD	1			
9	Professor and HOD Cabin	3			
10	Demonstration Room 1		8		
11	Associate Professor	2			
12	Assistant Professor	4	1		
13	Tutors Room	2			
14	Demonstration Room 2	3			
15	Forensic Serology Lab	2			
16	JP Modi Practical Hall	11		4	
Pathology					
Ground Floor					
1	Department Office	2			
2	Demo Room 1	4			
3	Practical Room	12		36	
4	Preparation Room		1		
5	Histopathology Lab		4		
6	Associate Professor 1			1	
7	Non-Teaching Room		1		
8	Lecture Theatre		11		
9	Associate Professor 2	1			
10	Associate Professor 3	1			
First Floor					
1	Preparation and Balance Room	4			
2	Library & Seminar Room	1			
3	Practical Lab Clinical Path/Hematology	15	1		
3	Research Lab Assistant Professor 1	4			
4	Research Lab Assistant Professor 2	1			
5	Tutors Room	1	1		
6	Museum	8			
Pharmacology					
Ground Floor					
1	Research Lab	4			
2	Office	1			
3	Asst Prof/Lecturer	2			
4	Professor and HOD Cabin		1		1
5	Demo Room 1		8		
6	Experimental Pharmacology Lab	14			
7	Preparation Room 1	2			
8	Asst Prof 1		1		1
9	Asst Prof 2		1		

No	Location	TFL (MB)		LED			CFL
		40 W	36 W	36W	18W	15W	23 W
Pharmacology							
First Floor							
1	Tutors Room	1					
2	Museum	8					
3	Demo Room 2	4					
4	Seminar Room	2					
5	Clinical Pharmacy and Lab	10					
6	Preparation Room	2					
Microbiology							
Ground Floor							
1	Lecture Hall G2	9		1			
2	David Bruce Lecture Hall	17	1				
3	Department Office	1					
4	HOD Office			1	1		
5	Non-Teaching Sraffa Room		2				
6	Anatomy Demo Room 1	10					
7	Anatomy Demo Room 2	4					
8	Division of Human Genetics		1				
9	Staff Room Junior	1					
10	Lecture Hall G3						
11	Dhanwanatri Hall Museum		24				
12	Preparation Room		1				
12	Modeler's Room		1				
First Floor							
1	State Reference Lab for HIV Testing		2				
2	Tutor 2	2		1			
3	State Reference Lab		1				
4	Tutor-3		2				
5	Library/Seminar		2				
6	Media Preparation & Storage	2					
7	Autoclaving	2					
8	Lecturer	2					
9	Demo Hall 1		3				
10	Professor 1		2				
11	Professor 2	1					
12	Asst Professor	2					
13	Demo Hall 2	6					
14	Grams Practical Hall	14					
15	Preparation Room	2	1				
16	Robert Koch's Museum	5					
17	PG Research Lab	3					
18	Assoc Professor 1	1					
19	Assoc Professor 2	1					
20	Bacteriology		1		2		
21	Serology		4				1

No	Location	TFL (MB)		LED				CFL
		40 W	36 W	36W	22W	18W	15W	23 W
Microbiology								
First Floor								
22	Immunology		4					
23	Parasitology		4					
24	Mycology							2
25	Mycobacteriology							3
Basement								
1	Sushruther/Dissection Hall		28					
2	Category Department			3				
3	Histological Practical Hall UG	40						
4	Preparation Room		1	1				
5	Demo Room 1	3	2					
6	Department Library, Seminar Hall	1						
7	Staff, Senior Asst Prof 1		1					
8	Staff, Senior Asst Prof 2	1						
9	Staff, Senior Asst Prof 3	1						
10	Staff, Senior Asst Prof 4	1						
11	Senior Staff Cabin Corridor		1					
12	Cadaver Lab		3				1	
13	College Council Hall	4						1
14	Office			1				
15	Xerox Machine Room			2				
16	Principal Cabin, Waiting Room				3			
17	Principal Cabin				4			
Hospital								
Ground Floor								
1	OPD Medicine		7					
2	Demo Room	2						
3	OPD Surgery	10	3	1				
4	Coffee Shop			2				
5	OPD Obstetrics		7	4				
6	Gynecology & F.W.	3						
7	Gynae Exam Room	2						
8	Office	5						
9	PNC Ward	10						
10	Ground Floor Passage			1				

No	Location	TFL (MB)		LED				CFL	
		40 W	36 W	36 W	22 W	18 W	15 W	23 W	14 W
Hospital									
Ground Floor									
11	Cash Counter		4						
12	Obstetrics & Gynecology Obstetric Ward		6	1	23	12			
13	Department of Emergency Medicine			6					
14	Casualty Room		8						8
15	Department of Radio Diagnosis & Imaging Sciences						13		
16	High Risk Obstetric Clinic						4		
17	Department of Radiology & Imaging						14		
18	Color Doppler MRI & CT Scan					8			
19	Assistant Superintendent		1	2					
20	Drugs Store-1		6						
21	Central Pathology Lab					12			
22	Clinical Biochemical Lab					20			
23	Respiratory Medicine-1	1	2						
24	Respiratory Medicine-2	6							
25	Respiratory Medicine-3	1							
26	Microbiology Lab					8			
27	Drugs Store-2		4						
28	Empanelment Office	3	1						
29	ICTC Centre					4			
30	OPD Dermatology, Venerology & Leprosy					15			
31	Blood Bank					3	11		5
32	OPD Ear, Nose & Throat								
33	OPD Orthopedics	1	17						
34	OPD Pediatrics		12						
35	OPD Eye					40			
36	Physiotherapy Centre	10						5	
37	Male Orthopedic Ward-1	11						3	
38	Male Orthopedic Ward-2		26					17	
First Floor									
1	Old K Block		24	6				10	
2	Old J Block		23					10	
3	Kaveri Ward		25					4	
4	Boys Common Room		2					6	
5	NICU		11						
6	Dental M-Block		30					20	
7	O.T.Complex		50					6	
8	Medical Superintendent							1	
9	Principal Office							1	

No	Location	TFL (MB)		LED				CFL	
		40 W	36 W	36 W	22 W	18 W	15 W	23 W	14 W
Hospital									
First Floor									
10	Nursing Superintendent		3					1	
11	SICU							1	
12	Post-Operative Ward		16					6	
13	Female Surgical Ward		28					13	
14	O.B.G Department		10					4	
15	Male Surgical-1		28					10	
16	Male Surgical-2		28					12	
17	Critical Care Ward				52				
Second Floor									
1	Male Medical Ward-1		27					17	
2	Male Medical Ward-2		9					15	
3	Pediatrics Department		10					1	
4	Female Medicinal Ward		25					11	
5	Chest & TB ward		21					12	
6	Dialysis Unit		10					6	
7	Medical Illustration			63					
8	Medical Education		11						
9	Ortho Department		7					6	
10	Boys Common Room		6					1	
11	Record Room		12						
12	Lecture Hall-1		10					11	
13	Museum		11					5	
14	Medicine Community Department		8	26				6	
15	Drug Store	2	2					3	
16	Department of Otorhinolaryngology		5						
17	Research Unit	4	2						
18	Dermatology Ward	4	2					5	
19	Department of Medicine	6	3			2			
20	Department of Ophthalmology Surgery, Dermatology, Venerology & Leprosy	9		9					
21	Passage	3		9					

No	Location	TFL (MB)		LED				CFL		PL
		40 W	36 W	36 W	22 W	18 W	15 W	23 W	14 W	18 W
Third Floor										
1	Institute			8	2			30		
2	Pediatric Ward							10		
3	NICU Unit		4							
4	PICU Unit	2		1						
5	Female Skin Ward						14		22	
6	Male Skin Ward			5		2	3	7		
7	Post-Operative Ward			5	5				5	
8	Critical Care Unit			30						
9	Post Anesthetic Care Unit			3					5	
10	Deputy Medical Superintendent					4				
11	Drug Store Passage					58				
12	Drug Store					3				
13	Pre Operation Theatre							3		
14	Operation Theatre-1									8
15	Operation Theatre-2									8
16	Operation Theatre-3									8
17	Operation Theatre-4									8
18	Operation Theatre-5									8
19	M Block-3		16	10				36		
20	Burn Ward		4					17		
21	J Block		10	10				34		
22	K Block		4	9				38		
University Building										
Ground Floor										
1	Waiting Lounge		6							12
2	Information Cell			2				1		
3	Finance Section		7		2			1		14
4	Academic Section				2		8			8
5	Store Room		2							
6	Deputy Registrar				4					
7	Professor J.G. Ambekar Registrar		1			3				24
8	Ground Floor Passage		6							
9	Registrar Office					4	2			2
10	Waiting Room		5					2		
11	Reception Area		14			14				
First Floor										
1	Dean Research & Development		4			4		1		2
2	Dr.M.B.Patil Chancellor & Board Room		14	33		24			9	
3	Vice Chancellor					14	4			28
4	1st floor passage		9							

No	Location	TFL (MB)		LED				CFL		PL
		40 W	36 W	36 W	22 W	18 W	15 W	23 W	14 W	18 W
University Building										
Second Floor										
1	Internal Quality Assurance Cell					15	3			
2	COE Office		8							
3	NAD Cell Officer									16
4	Supporting Staff Computer									16
5	Server Section			3						
6	Dr.S.S.M controller of Examination			4					6	
7	Moderators Room			1				1		
8	Vice Principal Cabin			8						
9	2nd Floor Passage			11						
Construction Cell										
1	Entry passage			10						
2	Resident Engineer Cabin						10			
3	U.N.Karadi Cabin						8			
Halkatti Bhavan(New Building)										
1	Library				9			5	1	
2	Meeting Hall							8	5	
3	Office			3				5		
Halkatti Bhavan(Old Building)										
1	1st Floor	17	13							
2	2nd Floor	1						4	21	
Printing Room										
1	Room No. 1	1	6							
2	Room No. 2		1							
3	Room No. 3	1	3			4				
4	Room No. 4		1							
Gymnasium										
1	Gym		14			3				
Central Animal House										
1	Central Animal House					10				
NRI Guest House										
1	Guest House		11			9				
Ladies Hostel										
1	Ladies Hostel		423			72		34		
NRI A										
1	NRI A Hostel		76			20		64		
NRI B										
1	NRI B Hostel		76			20		64		
Boys Hostel										
1	Junior Gents Hostel-3		86			12				
2	Junior Gents Hostel-2		86			12				
4	PG2		86			12				
Total		**413**	**1829**	**393**	**121**	**473**	**95**	**601**	**87**	**162**

TFL: Tubular Florescent Lamps (Tube lights)
CFL: Compact Florescent Lamps
MB: Magnetic Ballast
EB: Electronic Ballast

LED Lamps:

The efficacy of LED lamps is 100 to 140 lumens per watt as against 80-90 for TFLs; 60 to 70 for CFLs. The light emittance of LED is typically 120 to 140° Cone as against 360° for all the other fittings. It is therefore possible to save 40 to 60% energy by replacing various lamps with LED.

The economics has been worked out for various lamps; the details are as under.

Description	Unit	TFL		PL
		40 W	36 W	18 X 2 W
Rating of the lamp	Watt	40	36	36
Rating of the switchgear	Watt	15	15	5
Power consumption of the lamp	Watt	55	51	41
Alternative Lamp: LED Lamp				
Rating of the lamp	Watt	18	18	22
Rating of the switchgear	Watt	2	2	2
Power consumption of the lamp	Watt	20	20	24
Controllable loss				
Loss	Watt	35	31	17
	% Present	64%	61%	41%
Saving Potential				
Number of lamps	No	413	1829	81
Cost of power	Rs/kWh	8.6	8.6	8.6
Operating Period	Hr/Day	4	4	6
	Day/Month	23	23	23
Energy Saving	kW	14.46	56.70	1.38
	kWh/Month	1330	5216	190
	Rs/Month	11420	44796	1632
Economics				
Investment	Rs	185850	823050	44550
Payback period	Month	16.3	18.4	27.3

The total savings work out to 6736 kWh or Rs 57,849/- per month.

The investment shall be around Rs 10,53,450/-.

The payback period works out to 18.2 months.

Power Consumption:

The power consumption of some of the motors and gadgets is as under.

Equipment	Starter	Voltage	Current	PF	Power
		V	Amps		kW
Air Conditioners-Direct AHUs					
3rd Floor ICU A Side	DOL	407.9	32.1	0.84	19.0
3rd Floor ICU B Side	DOL	417.2	35.7	0.84	21.6
1st Floor ICU A Side	DOL	409.5	37.8	0.81	21.7
1st Floor ICU B Side	DOL	411.1	26.1	0.78	14.5
OT 1	DOL	423.9	23.3	0.79	13.5
OT 2	DOL	443.2	19.9	0.72	11.0
OT 3	DOL	431.3	24.7	0.81	14.9
OT 4	DOL	406.7	27.0	0.80	15.2
OT 5	DOL	409.3	26.2	0.78	14.5
MRI Technical Room (8.5 TR)	DOL	417.6	19.1	0.76	10.5
MRI Room Technical (5.5 TR)	DOL	419.5	7.2	0.72	3.8
MRI-1 (5.5 TR)	DOL	419.7	7.1	0.71	3.7
MRI-2 (5.5 TR)	DOL	419.1	7.2	0.72	3.8
MRI Reporting Room (5.5 TR)	DOL	420.0	7.3	0.73	3.9
AHUs Fan					
3rd Floor ICU A Side	DOL	407.8	9.9	0.81	5.67
3rd Floor ICU B Side	DOL	407.1	9.5	0.80	5.4
1st Floor ICU A Side	DOL	406.4	8.6	0.63	3.8
1st Floor ICU B Side	DOL	406.8	8.6	0.80	4.8
OT 1	DOL	425.4	6.6	0.64	3.1
OT 2	DOL	442.1	6.9	0.59	3.1
OT 3	DOL	430.2	6.1	0.65	2.9
OT 4	DOL	406.3	6.5	0.63	2.9
OT 5	DOL	410.8	6.8	0.66	3.2
Corridor 2	DOL	414.6	3.6	0.72	1.9
Air Conditioner-Split Units					
Hospital					
Sever Room AC 1	DOL	231.2	5.0	0.88	1.0
M Block, VIP Room AC 2	DOL	230.9	7.9	0.79	1.4
Burn Ward	DOL	229.3	12.3	0.71	2.0
Central Library					
Gr Floor, PG Hall, AC 2	DOL	429.8	7.7	0.68	3.9
Gr Floor, PG Hall, AC 5	DOL	430.5	7.6	0.68	3.9
Digital Library, AC 9	DOL	240.0	8.4	0.93	1.9
Digital Library, AC 5	DOL	244.1	8.6	0.92	1.9
University Building					
COE Office	DOL	239.5	8.0	0.83	1.6
NAD Cell	DOL	234.8	7.3	0.84	1.4
Chancellor	DOL	227.1	12.5	0.81	2.3

Equipment	Starter	Voltage	Current	PF	Power
		V	Amps		kW
Construction Cell					
Resident Engineer	DOL	231.1	5.1	0.86	1.0
Pumps					
Swimming Pool Pump 2	DOL	417.4	20.1	0.87	12.7
Swimming Pool Pump 4	DOL	410.1	17.7	0.84	10.5
Estate Office Pump	DOL	415.7	11.1	0.79	6.3
Air Compressor 2	DOL	402.1	20.6	0.88	12.6
Air Compressor 3	DOL	402.5	20.4	0.77	10.9
Electronic Gadgets					
PC					
Central Library, UG Hall	DOL	242.1	0.4	0.84	0.08
Hospital, RMO PC	DOL	237.4	0.4	0.57	0.06
Hospital, Admin PC	DOL	235.9	0.3	0.88	0.07
Hospital, Cash Counter PC 7	DOL	221.1	0.1	0.52	0.02
Hospital, Cash Counter PC 2	DOL	221.9	0.1	0.54	0.02
PC Asst Registrar	DOL	228.4	0.4	0.53	0.05
Printing Press					
Auto print Machine	DOL	234.1	5.1	0.94	1.1
Printoram 164	DOL	415.6	3.9	0.56	1.6
Printer					
Hospital, Admin	DOL	235.9	1.8	0.89	0.4
Hospital, Cash Counter 2	DOL	221.9	1.9	0.88	0.4
University Bldg. Admin Printer	DOL	229.4	1.9	0.99	0.4
University Bldg. Admin Xerox m/c	DOL	229.4	2.2	0.99	0.5
Water Cooler					
Guest House Canteen Water Cooler	DOL	224.8	7.9	0.81	1.4
Girls Hostel 1st Floor, Bldg. 3	DOL	230.1	8.6	0.80	1.6
Girls Hostel 2nd Floor Bldg. 2	DOL	231.2	8.4	0.82	1.6
Girls Hostel 2nd Floor Bldg. 1	DOL	229.5	8.2	0.81	1.5
Boys Hostel 2	DOL	228.9	8.0	0.79	1.4
Boys Hostel 3	DOL	230.1	8.4	0.80	1.5
NRI A	DOL	225.2	7.8	0.76	1.3
NRI B	DOL	226.1	8.2	0.77	1.4

Fan Fittings:

Sr No	Location	Rating	Quantity
		W	No
Central Library			
Ground Floor			
1	Post Graduate Section	60	8
2	Under Graduate Section	60	8
4	Library Cabin	60	1
First Floor			
1	Reading Room	60	3
Second Floor			
1	UG-Reading Hall 1	60	4
2	PG-Reading Hall	60	9
3	UG-Reading Hall 3	60	20
Physiology			
Ground Floor			
1	Department Library Seminar Room	60	1
2	Demonstration Room-1	60	3
3	Assistant Professor	60	1
4	Associate Professor-1	60	1
5	Associate Professor-2	60	1
6	Associate Professor-3	60	1
7	Associate Professor-4	60	1
8	Professor and HOD Cabin	60	1
9	Demonstration Room-2	60	3
10	Associate Professor-5	60	1
11	Associate Professor-6	60	1
12	Associate Professor-7	60	1
13	Associate Professor-8	60	1
14	Associate Professor-9	60	1
15	Research Lab	60	4
16	Human Clinical Lab	60	6
17	Department Library Seminar Lab	60	2
18	Demonstration Room-3	60	3
19	Department Office	60	2
20	Practical Class	60	8
21	Laboratory Room	60	6
22	Associate Professor-10	60	1
23	Associate Professor-11	60	1
First Floor-Forensic Department			
1	Research Lab	60	2
2	Department Library Seminar Room	60	2
3	Edmund Lockard's Museum	60	4
4	Hematology Lab	60	11
5	Amphibian Lab	60	6
6	Mammalian Lab	60	4

Sr No	Location	Rating	Quantity
		W	No
Physiology			
First Floor-Forensic Department			
6	Mammalian Lab	60	4
7	Department Office	60	1
8	Assistant HOD	60	1
9	Professor and HOD Cabin	60	2
10	Demonstration Room 1	60	7
11	Associate Professor	60	2
12	Assistant Professor	60	2
13	Tutors Room	60	2
14	Demonstration Room 2	60	6
15	Forensic Serology Lab	60	1
16	JP Modi Practical Hall	60	12
Pathology			
Ground Floor			
1	Department Office	60	2
2	Demo Room 1	60	3
3	Practical Room	60	6
4	Preparation Room	60	2
5	Histopathology Lab	60	3
6	Associate Professor 1	60	1
7	Non-Teaching Room	60	1
8	Lecture Theatre	60	7
9	Associate Professor 2	60	1
10	Associate Professor 3	60	1
First Floor			
1	Preparation and Balance Room	60	4
2	Library & Seminar Room	60	2
3	Practical Lab Clinical Path/Hematology	60	9
3	Research Lab Assistant Professor 1	60	4
4	Research Lab Assistant Professor 2	60	1
5	Tutors Room	60	2
6	Museum	60	7
Pharmacology			
Ground Floor			
1	Research Lab	60	3
2	Office	60	1
3	Asst Prof/Lecturer	60	1
4	Professor and HOD Cabin	60	1
5	Demo Room 1	60	6
6	Experimental Pharmacology Lab	60	8
7	Preparation Room 1	60	1
8	Asst Prof 1	60	1
9	Asst Prof 2	60	1

Sr No	Location	Rating	Quantity
		W	No
Pharmacology			
First Floor			
1	Tutors Room	60	2
2	Museum	60	4
3	Demo Room 2	60	5
4	Seminar Room	60	2
5	Clinical Pharmacy and Lab	60	7
6	Preparation Room	60	1
Microbiology			
Ground Floor			
1	Lecture Hall G2	60	11
2	David Bruce Lecture Hall	60	11
3	Department Office	60	1
4	HOD Office	60	1
5	Non-Teaching staff Room	60	1
6	Anatomy Demo Room 1	60	9
7	Anatomy Demo Room 2	60	2
8	Division of Human Genetics	60	1
9	Staff Room Junior	60	1
10	Lecture Hall G3	60	9
11	Dhanwanatri Hall Museum	60	14
12	Preparation Room	60	1
12	Modeler's Room	60	1
First Floor			
1	State Reference Lab for HIV Testing	60	1
2	Tutor 2	60	1
3	State Reference Lab	60	1
4	Tutor-3	60	1
5	Library/Seminar	60	2
6	Media Preparation & Storage	60	1
7	Autoclaving	60	1
8	Lecturer	60	1
9	Demo Hall 1	60	4
10	Professor 1	60	1
11	Professor 2	60	1
12	Asst Professor	60	2
13	Demo Hall 2	60	6
14	Grams Practical Hall	60	9
15	Preparation Room	60	1
16	Robert Koch's Museum	60	4
17	PG Research Lab	60	3
18	Assoc Professor 1	60	1
19	Assoc Professor 2	60	1
20	Bacteriology	60	1

Sr No	Location	Rating	Quantity
		W	No
Microbiology			
First Floor			
21	Serology	60	1
22	Immunology	60	1
23	Parasitology	60	1
24	Mycology	60	1
Basement			
1	Sushruther/Dissection Hall	60	16
2	Category Department	60	4
3	Histological Practical Hall UG	60	16
4	Preparation Room	60	1
5	Demo Room 1	60	5
6	Department Library, Seminar Hall	60	2
7	Staff, Senior Asst Prof 1	60	1
8	Staff, Senior Asst Prof 2	60	1
9	Staff, Senior Asst Prof 3	60	1
10	Staff, Senior Asst Prof 4	60	1
11	Senior Staff Cabin Corridor	60	1
12	Cadaver Lab	60	4
13	College Council Hall	60	2
14	Office	60	6
15	Xerox Machine Room	60	1
16	Principal Cabin, Waiting Room	60	1
17	Principal Cabin	60	2
Hospital			
Ground Floor			
1	OPD Medicine	60	6
2	Demo Room	60	1
3	OPD Surgery	60	2
4	Coffee Shop	60	2
7	Gynae Exam Room	60	2
8	Office	60	7
9	PNC Ward	60	8
12	Obstetrics & Gynecology Obstetric Ward	60	22
13	Department of Emergency Medicine	60	6
14	Casualty Room	60	7
17	Department of Radiology & Imaging	60	2
19	Assistant Superintendent	60	2
20	Drugs Store-1	60	6
23	Respiratory Medicine-1	60	2
24	Respiratory Medicine-2	60	3
25	Respiratory Medicine-3	60	1
27	Drugs Store-2	60	5
28	Empanelment Office	60	4
30	OPD Dermatology, Venerology & Leprosy	60	14

Sr No	Location	Rating	Quantity
		W	No
Hospital			
Ground Floor			
32	OPD Ear, Nose & Throat	60	11
33	OPD Orthopedics	60	17
34	OPD Pediatrics	60	6
36	Physiotherapy Centre	60	5
37	Male Orthopedic Ward-1	60	6
38	Male Orthopedic Ward-2	60	15
First Floor			
1	Old K Block	60	35
2	Old J Block	60	24
3	Kaveri Ward	60	25
4	Boys Common Room	60	6
5	NICU	60	3
6	Dental M-Block	60	25
7	O.T.Complex	60	32
8	Medical Superintendent	60	6
9	Principal Office	60	6
10	Nursing Superintendent	60	2
12	Post-Operative Ward	60	9
13	Female Surgical Ward	60	18
14	O.B.G Department	60	10
15	Male Surgical-1	60	15
16	Male Surgical-2	60	23
Second Floor			
1	Male Medical Ward-1	60	19
2	Male Medical Ward-2	60	16
3	Pediatrics Department	60	10
4	Female Medicinal Ward	60	17
5	Chest & TB ward	60	16
6	Dialysis Unit	60	6
7	Medical Illustration	60	16
8	Medical Education	60	8
9	Ortho Department	60	8
10	Boys Common Room	60	3
11	Record Room	60	5
12	Lecture Hall-1	60	8
13	Museum	60	6
14	Medicine Community Department	60	27
15	Drug Store	60	2
16	Department of Otorhinolaryngology	60	3
17	Research Unit	60	6
18	Dermatology Ward	60	7
19	Department of Medicine	60	8

Sr No	Location	Rating	Quantity
		W	No
Hospital			
Second Floor			
20	Department of Ophthalmology, Surgery, Dermatology, Venerology & Leprosy	60	13
21	Passage	60	3
Third Floor			
1	Institute	60	31
2	Pediatric Ward	60	10
3	NICU Unit	60	10
4	PICU Unit	60	4
5	Female Skin Ward	60	22
6	Male Skin Ward	60	10
7	Post-Operative Ward	60	12
9	Post Anesthetic Care Unit	60	10
11	Drug Store Passage	60	18
13	Pre Operation Theatre	60	8
19	M Block-3	60	24
20	Burn Ward	60	21
21	J Block	60	24
22	K Block	60	38
University Building			
Ground Floor			
1	Waiting Lounge	60	1
2	Information Cell	60	2
3	Finance Section	60	2
4	Academic Section	60	6
5	Store Room	60	1
6	Deputy Registrar	60	1
7	Professor J.G. Ambekar Registrar	60	1
9	Registrar Office	60	2
10	Waiting Room	60	1
First Floor			
1	Dean Research & Development	60	2
2	Dr.M.B.Patil Chancellor & Board Room	60	2
3	Vice Chancellor	60	3
4	1st floor passage	60	2
Second Floor			
1	Internal Quality Assurance Cell	60	2
2	COE Office	60	6
3	NAD Cell Officer	60	3
6	Dr.S.S.M controller of Examination	60	2

Sr No	Location	Rating	Quantity
		W	No
University Building			
Second Floor			
7	Moderators Room	60	1
8	Vice Principal Cabin	60	2
Construction Cell			
1	Entry passage	60	6
2	Resident Engineer Cabin	60	1
3	U.N.Karadi Cabin	60	1
Halkatti Bhavan(New Building)			
1	Library	60	14
2	Meeting Hall	60	4
3	Office	60	4
Halkatti Bhavan(Old Building)			
1	1st Floor	60	12
2	2nd Floor	60	10
Printing Room			
1	Room No. 2	60	1
2	Room No. 4	60	1
Gymnasium			
1	Gym	60	6
Central Animal House			
1	Rest Room	60	1
2	Rats	60	1
3	Quarantine	60	1
4	Mice	60	1
5	Store Room	60	1
6	Rabbits	60	1
7	Operation Theatre	60	1
8	Guinea Pigs	60	1
10	Office-2	60	1
NRI Guest House			
1	Guest House	60	23
Ladies Hostel			
1	Ladies Hostel	60	210
NRI A			
1	NRI A Hostel	60	64
NRI B			
1	NRI B Hostel	60	64
Boys Hostel			
1	Junior Gents Hostel-3	60	36
2	Junior Gents Hostel-2	60	36
4	PG2	60	36

Opportunity for Conservation of energy:

Energy Efficient Fans:

The possibility of replacing the fans with energy efficient new fans may be evaluated. These fans can save 50 to 60% energy while delivering similar air flows.

The expected saving works out to about Rs 700/- per year per fan.

The investment shall be in the range of Rs 3,500/- per fan; giving a payback period of 60.0 months

The installation of energy efficient fans may be considered for new purchases.

Transformer :

The loading pattern were studied and the details are as under,

Description		Unit	Transformer			
			HT 76	HT 14 New	HT 14 250 KVA	HT 14 Old
Rated Parameter						
Make			NA	NA	NA	NA
TR Capacity		kVA	500	500	250	500
Voltage	Primary	kV	11.0	11.0	11.0	11.0
	Secondary	kV	0.415	0.415	0.415	0.415
Actual Parameter						
CT Ratio	Primary	A	1000	800	800	800
	Secondary	A	5	5	5	5
PT Ratio	Primary	V	No PT	No PT	No PT	No PT
	Secondary	V				
Voltage		kV	0.422	0.419	0.410	0.426
Current		A	123.2	106.0	102.5	216.2
Power Factor			0.80	0.91	0.99	0.94
Total Power		kW	64.8	60.4	67.1	134.8
		kVA	80.8	66.2	67.9	142.9
Total Harmonic Distortion - Voltage (V_{thd})	R phase	%	3.23	2.97	1.44	2.41
	Y phase	%	3.58	2.49	1.61	2.56
	B phase	%	2.89	2.61	1.73	2.78
	Max	%	3.58	2.97	1.73	2.78
Total Harmonic Distortion - Current (I_{thd})	R phase	%	19.32	9.09	6.23	7.72
	Y phase	%	24.09	7.08	5.65	7.71
	B phase	%	22.75	6.81	8.64	7.85
	Max	%	24.09	9.09	8.64	7.85
Average loading		%	16.2%	13.2%	27.2%	28.6%

The loading is satisfactory and no major savings are expected in this area.

Cable loss:

The voltage drop was measured for major load; the details are as under.

Description	Voltage - PCC			Voltage - MCC			Loss
	V_R	V_Y	V_B	V_R	V_Y	V_B	%
Transformer 1, HT 76, 500 KVA							
PCC to Medical College Building	238.6	239.1	236.5	237.1	235.2	232.3	1.3%
PCC to Physiology	235.2	236.8	237.1	233.3	232.5	235.3	1.1%
PCC to Library AC Supply	242.3	243.2	244.1	240.2	241.3	242.2	0.8%
PCC to Library	242.1	243.0	243.9	241.1	240.9	241.3	0.8%
PCC to Anatomy Building	230.8	231.2	229.5	227.3	228.1	228.2	1.1%
PCC to Ladies Hostel	232.1	235.5	244.9	229.0	233.3	243.2	1.0%
PCC to Halkatti Building	225.8	224.4	226.3	221.3	221.3	223.5	1.5%
Transformer 2, HT 14, New 500 KVA							
PCC to 3rd Floor Hospital	237.9	238.6	239.1	235.3	236.1	236.3	1.1%
Transformer 3, HT 14 Old 500 KVA							
PCC to Gnd,1st and 2nd Floor Hospital	241.3	242.6	243.1	238.2	240.3	238.1	1.4%
Transformer 4, HT 14, 250 KVA							
PCC to NRI B	225.9	226.2	226.4	223.1	222.3	224.2	1.3%
PCC to Guest House & NRI A	226.0	226.6	225.0	222.9	221.4	224.3	1.3%
PCC to Estate Office Pump Supply	244.2	242.3	241.5	241.2	240.5	237.6	1.2%
PCC to Boys Hostel No.2	230.2	231.5	232.4	228.3	227.2	230.4	1.2%
PCC to Boys Hostel No.3	231.1	229.3	230.8	229.2	226.3	227.9	1.1%
PCC to University Office Building	233.5	233.9	234.8	230.1	229.5	232.1	1.5%

Voltage and Current Imbalance:

The details are as under,

Description	HT 76, 500 KVA	HT 14, New 500 KVA	HT 14, Old 500 KVA	HT 14, 250 KVA
Voltage (V)				
V_R	242.7	240.6	246.2	237.3
V_Y	242.4	242.1	245.7	235.7
V_B	244.3	241.2	245.1	236.2
V_{avg}	243.1	241.3	245.7	236.4
V_{max}	244.3	242.1	246.2	237.3
V_{min}	242.4	240.6	245.1	235.7
Imbalance (%)	0.5%	0.3%	0.2%	0.4%
Current (A)				
I_R	118.1	104.8	216.2	99.8
I_Y	123.2	99.1	169.3	102.5
I_B	114.5	106.0	214.3	96.5
I_{avg}	118.6	103.3	199.9	99.6
I_{max}	123.2	106.0	216.2	102.5
I_{min}	114.5	99.1	169.3	96.5
Imbalance (%)	3.9%	2.6%	8.1%	2.9%

The voltage and current imbalance are within the stipulated limit.

Capacitor Bank:

Description	Rating		Current (Amp)					Remark
	kVAr	Amp	R_{ph}	Y_{ph}	B_{ph}	Minimum	% Rated	
HT 76 (50 KVAR)								
Capacitor Bank 1	20.0	26.0	24.4	24.2	32.3	24.2	93%	Functioning
Capacitor Bank 2	10.0	13.0	9.7	10.0	10.2	9.7	74%	Malfunctioning
Capacitor Bank 3	20.0	26.0	31.3	31.6	32.0	26.0	100%	Functioning
HT 14 (70 KVAR)								
Capacitor Bank 1	5.0	6.5	0.0	0.0	0.0	0.0	0%	Malfunctioning
Capacitor Bank 2	5.0	6.5	4.4	4.0	4.4	4.0	62%	Malfunctioning
Capacitor Bank 3	10.0	13.0	12.8	13.1	12.8	12.8	98%	Functioning
Capacitor Bank 4	10.0	13.0	12.9	13.0	12.5	12.5	96%	Functioning
Capacitor Bank 5	10.0	13.0	12.8	12.7	12.8	12.7	98%	Functioning
Capacitor Bank 6	15.0	19.5	19	19.3	18.9	18.9	97%	Functioning
Capacitor Bank 7	15.0	19.5	19	19.3	19.2	19.0	97%	Functioning
HT 14 (20 KVAR)								
Capacitor Bank 2	10.0	13.0	9.2	6.7	3.7	3.7	28%	Malfunctioning
Capacitor Bank 2	10.0	13.0	12.6	12.6	12.3	12.3	95%	Functioning
Old HT 14 (50 KVAR)								
Capacitor Bank 2	25.0	32.5	10.9	13.6	10.4	10.4	32%	Malfunctioning
Capacitor Bank 2	25.0	32.5	9.0	11.5	11.3	9.0	28%	Malfunctioning

Observations & Recommendations :

Most of the capacitors are functioning properly.

The corrective actions may be needed to repair / replace the faulty capacitors.

Chapter - IV
Energy Management & Efficiency

Illumination

The illumination level was measured at various locations; the details are as under.

No	Location	Illumination (LUX)		
		Max	Min	Avg
Central Library				
Ground Floor				
1	Post Graduate Section	468	142	327
2	Under Graduate Section	415	112	290
3	Library Entrance	218	91	149
4	Library Cabin	75	45	61
First Floor				
1	Reading Room	198	59	124
Second Floor				
1	UG-Reading Hall 1	397	127	254
2	PG-Reading Hall	233	137	188
3	UG-Reading Hall 3	238	82	151
4	Digital Library	78	16	48
5	Stock Room	420	58	270
Physiology				
Ground Floor				
1	Department Library Seminar Room	132	110	119
2	Demonstration Room-1	81	72	76
3	Assistant Professor	74	65	70
4	Associate Professor-1	215	81	113
5	Associate Professor-2	95	90	93
6	Associate Professor-3	176	90	132
7	Associate Professor-4	234	53	115
8	Professor and HOD Cabin	122	28	73
9	Demonstration Room-2	122	78	104
10	Associate Professor-5	114	84	98
11	Associate Professor-6	98	75	86
12	Associate Professor-7	97	83	90
13	Associate Professor-8	99	71	81
14	Associate Professor-9	131	72	89
15	Research Lab	150	95	121
16	Human Clinical Lab	110	47	73
17	Department Library Seminar Lab	55	27	40
18	Demonstration Room-3	75	32	55
19	Department Office	180	75	137
20	Practical Class	158	36	97

No	Location	Illumination (LUX)		
		Max	Min	Avg
Physiology				
Ground Floor				
21	Laboratory Room	313	150	233
22	Associate Professor-10	68	43	54
23	Associate Professor-11	61	36	49
First Floor-Forensic Department				
1	Research Lab	78	31	50
2	Department Library Seminar Room	70	29	47
3	Edmund Lockard's Museum	390	92	260
4	Hematology Lab	313	48	204
5	Amphibian Lab	123	24	71
6	Mammalian Lab	72	24	52
7	Department Office	68	53	61
8	Assistant HOD	86	73	80
9	Professor and HOD Cabin	115	79	102
10	Demonstration Room 1	240	85	134
11	Associate Professor	135	66	106
12	Assistant Professor	79	55	66
13	Tutors Room	80	56	70
14	Demonstration Room 2	73	52	63
15	Forensic Serology Lab	49	33	40
16	JP Modi Practical Hall	92	45	73
Pathology				
Ground Floor				
1	Department Office	112	20	60
2	Demo Room 1	60	27	43
3	Practical Room	240	37	135
4	Preparation Room	144	67	109
5	Histopathology Lab	432	88	218
6	Associate Professor 1	72	48	58
7	Non-Teaching Room	86	50	68
8	Lecture Theatre	143	56	107
9	Associate Professor 2	52	43	48
10	Associate Professor 3	60	42	53
First Floor				
1	Preparation and Balance Room	109	85	94
2	Library & Seminar Room	120	49	92
3	Practical Lab Clinical Path/Hematology	181	86	127
3	Research Lab Assistant Professor 1	170	112	145
4	Research Lab Assistant Professor 2	140	96	116
5	Tutors Room	93	74	82
6	Museum	117	96	106

No	Location	Illumination (LUX)		
		Max	Min	Avg
Pharmacology				
Ground Floor				
1	Research Lab	77	54	66
2	Office	280	120	193
3	Asst Prof/Lecturer	336	180	266
4	Professor and HOD Cabin	117	83	101
5	Demo Room 1	143	127	134
6	Experimental Pharmacology Lab	189	115	156
7	Preparation Room 1	60	24	40
8	Asst Prof 1	78	50	64
9	Asst Prof 2	88	68	77
First Floor				
1	Tutors Room	219	110	160
2	Museum	146	86	121
3	Demo Room 2	128	96	109
4	Seminar Room	68	52	59
5	Clinical Pharmacy and Lab	181	127	159
6	Preparation Room	98	83	91
Microbiology				
Ground Floor				
1	Lecture Hall G2	122	43	84
2	David Bruce Lecture Hall	191	29	98
3	Department Office	98	42	75
4	HOD Office	161	105	132
5	Non-Teaching staff Room	325	105	221
6	Anatomy Demo Room 1	440	165	268
7	Anatomy Demo Room 2	425	168	306
8	Division of Human Genetics	255	130	178
9	Staff Room Junior	247	143	180
10	Lecture Hall G3	226	125	168
11	Dhanwanatri Hall Museum	148	71	120
12	Preparation Room	89	51	68
12	Modeler's Room	90	58	70
First Floor				
1	State Reference Lab for HIV Testing	70	37	54
2	Tutor 2	100	60	81
3	State Reference Lab	117	73	88
4	Tutor-3	115	79	102
5	Library/Seminar	323	276	305
6	Media Preparation & Storage	127	94	112
7	Autoclaving	238	196	218
8	Lecturer	142	123	133
9	Demo Hall 1	63	21	43
10	Professor 1	70	56	63
11	Professor 2	75	52	62

No	Location	Illumination (LUX)		
		Max	Min	Avg
Microbiology				
First Floor				
12	Asst Professor	277	112	211
13	Demo Hall 2	390	170	273
14	Grams Practical Hall	230	160	195
15	Preparation Room	160	71	127
16	Robert Koch's Museum	83	42	60
17	PG Research Lab	303	238	273
18	Assoc Professor 1	93	42	67
19	Assoc Professor 2	96	42	66
20	Bacteriology	200	146	171
21	Serology	138	75	109
22	Immunology	185	60	121
23	Parasitology	182	165	173
24	Mycology	175	161	168
25	Mycobacteriology	220	114	156
Basement				
1	Sushruther/Dissection Hall	188	118	152
2	Category Department	138	88	102
3	Histological Practical Hall UG	145	113	133
4	Preparation Room	89	68	77
5	Demo Room 1	127	59	89
6	Department Library, Seminar Hall	70	25	51
7	Staff, Senior Asst Prof 1	67	53	61
8	Staff, Senior Asst Prof 2	153	68	115
9	Staff, Senior Asst Prof 3	138	89	103
10	Staff, Senior Asst Prof 4	91	63	80
11	Senior Staff Cabin Corridor	117	93	104
12	Cadaver Lab	101	38	65
13	College Council Hall	59	43	51
14	Office	115	65	88
15	Xerox Machine Room	85	63	73
16	Principal Cabin, Waiting Room	167	112	141
17	Principal Cabin	117	76	96
Hospital				
Ground Floor				
1	OPD Medicine	92	70	80
2	Demo Room	81	65	72
3	OPD Surgery	135	88	112
4	Coffee Shop	73	56	65
5	OPD Obstetrics	102	76	90
6	Gynecology & F.W.	74	57	66
7	Gynae Exam Room	102	71	87
8	Office	80	63	71
9	PNC Ward	59	40	51

Sr No	Location	Illumination (LUX)		
		Max	Min	Avg
Hospital				
Ground Floor				
10	Ground Floor Passage	104	66	84
11	Cash Counter	79	67	73
12	Obstetrics & Gynecology Obstetric Ward	355	115	207
13	Department of Emergency Medicine	125	66	96
14	Casualty Room	54	32	42
15	Department of Radio Diagnosis & Imaging Sciences	132	104	119
16	High Risk Obstetric Clinic	357	313	336
17	Department of Radiology & Imaging	150	115	135
18	Color Doppler MRI & CT Scan	254	148	201
19	Assistant Superintendent	92	62	76
20	Drugs Store-1	63	48	58
21	Central Pathology Lab	96	77	87
22	Clinical Biochemical Lab	190	142	167
23	Respiratory Medicine-1	79	63	70
24	Respiratory Medicine-2	81	68	74
25	Respiratory Medicine-3	89	57	76
26	Microbiology Lab	150	115	135
27	Drugs Store-2	67	47	58
28	Empanelment Office	183	76	127
29	ICTC Centre	286	151	202
30	OPD Dermatology, Venerology & Leprosy	216	131	182
31	Blood Bank	48	33	40
32	OPD Ear, Nose & Throat	87	66	75
33	OPD Orthopedics	87	56	74
34	OPD Pediatrics	103	79	91
35	OPD Eye	121	91	106
36	Physiotherapy Centre	97	81	89
37	Male Orthopedic Ward-1	117	65	91
38	Male Orthopedic Ward-2	131	73	103
First Floor				
1	Old K Block	87	54	74
2	Old J Block	107	70	93
3	Kaveri Ward	116	65	90
4	Boys Common Room	110	70	92
5	NICU	168	74	130
6	Dental M-Block	110	50	81
7	O.T.Complex	158	73	115
8	Medical Superintendent	230	100	167
9	Principal Office	140	103	123
10	Nursing Superintendent	110	70	93
11	SICU	96	55	76
12	Post-Operative Ward	81	68	74

Sr No	Location	Illumination (LUX)		
		Max	Min	Avg
Hospital				
First Floor				
13	Female Surgical Ward	95	54	75
14	O.B.G Department	72	53	64
15	Male Surgical-1	96	55	76
16	Male Surgical-2	112	48	85
17	Critical Care Ward	182	156	169
Second Floor				
1	Male Medical Ward-1	156	111	137
2	Male Medical Ward-2	144	113	130
3	Pediatrics Department	100	48	69
4	Female Medicinal Ward	155	125	138
5	Chest & TB ward	90	70	80
6	Dialysis Unit	114	76	95
7	Medical Illustration	73	52	64
8	Medical Education	163	149	155
9	Ortho Department	76	50	66
10	Boys Common Room	76	51	63
11	Record Room	90	55	73
12	Lecture Hall-1	84	50	70
13	Museum	85	60	72
14	Medicine Community Department	73	54	65
15	Drug Store	83	51	67
16	Department of Otorhinolaryngology	79	52	68
17	Research Unit	79	51	64
18	Dermatology Ward	75	56	67
19	Department of Medicine	74	55	65
20	Department of Ophthalmology Surgery, Dermatology, Venerology & Leprosy	111	57	90
21	Passage	91	46	68
Third Floor				
1	Institute	639	374	487
2	Pediatric Ward	145	112	129
3	NICU Unit	151	109	130
4	PICU Unit	146	98	122
5	Female Skin Ward	473	174	314
6	Male Skin Ward	403	149	265
7	Post-Operative Ward	312	151	234
8	Critical Care Unit	59	41	49

Sr No	Location	Illumination (LUX)		
		Max	Min	Avg
Hospital				
Third Floor				
9	Post Anesthetic Care Unit	121	69	90
10	Deputy Medical Superintendent	223	88	153
11	Drug Store Passage	403	73	225
12	Drug Store	210	75	148
13	Pre Operation Theatre	353	112	241
14	Operation Theatre-1	250	75	176
15	Operation Theatre-2	241	66	167
16	Operation Theatre-3	245	70	171
17	Operation Theatre-4	247	72	173
18	Operation Theatre-5	237	63	163
19	M Block-3	210	72	152
20	Burn Ward	110	61	92
21	J Block	166	65	133
22	K Block	110	88	97
Admin Building (Deemed to be University)				
Ground Floor				
1	Waiting Lounge	110	70	92
2	Information Cell	168	74	130
3	Finance Section	110	50	81
4	Academic Section	158	73	115
5	Store Room	106	83	96
6	Deputy Registrar	140	103	123
7	Professor J.G. Ambekar Registrar	110	70	93
8	Ground Floor Passage	96	55	76
9	Registrar Office	81	68	74
10	Waiting Room	95	54	75
11	Reception Area	72	53	64
First Floor				
1	Dean Research & Development	63	21	43
2	Dr.M.B.Patil Chancellor & Board Room	70	56	63
3	Vice Chancellor	75	52	62
4	1st floor passage	89	51	68
Second Floor				
1	Internal Quality Assurance Cell	230	160	195
2	COE Office	90	54	69
3	NAD Cell Officer	280	120	196
4	Supporting Staff Computer	250	75	176
5	Server Section	241	66	167
6	Dr.S.S.M controller of Examination	180	120	154
7	Moderators Room	117	83	101
8	Vice Principal Cabin	96	55	76

Sr No	Location	Illumination (LUX)		
		Max	Min	Avg
Construction				
1	Entry passage	158	70	115
2	Resident Engineer Cabin	180	124	154
3	U.N.Karadi Cabin	140	103	123
Halkatti Bhavan(New Building)				
1	Library	107	37	79
2	Meeting Hall	144	67	109
3	Office	146	88	122
Halkatti Bhavan(Old Building)				
1	1st Floor	116	65	90
2	2nd Floor	110	70	92
Printing Room				
1	Room No. 1	137	108	123
2	Room No. 2	72	48	58
3	Room No. 3	86	50	68
4	Room No. 4	143	56	107
Gymnasium				
1	Gym	111	70	93
Central Animal House				
1	Rest Room	221	197	211
2	Rats	201	141	174
3	Quarantine	182	106	150
4	Mice	209	176	194
5	Store Room	211	188	201
6	Rabbits	233	189	207
7	Operation Theatre	221	178	200
8	Guinea Pigs	220	114	186
9	Office-1	239	217	229
10	Office-2	390	354	371
NRI Guest House				
Ground Floor				
1	Room No 4	67	55	61
2	Room No 5	153	68	116
3	Room No 6	111	89	98
4	Room No 7	91	64	80
5	Room No 8	117	91	103
6	Room No 9	90	54	69
7	Conference Hall	140	97	120
First Floor				
1	Room No 1	118	65	87
2	Room No 2	107	37	79
3	Room No 3	144	67	109
4	Conference Hall	146	88	122
5	Dining Hall	139	69	106

Sr No	Location	Illumination (LUX)		
		Max	Min	Avg
NRI Guest House				
Second Floor				
1	Room No 10	107	70	93
2	Room No 11	116	65	90
3	Room No 12	110	70	92
4	Room No 13	168	74	130
5	Room No 14	110	50	81
6	Room No 15	158	73	115
Ladies Hostel				
1	Hostel No 1	117	87	102
2	Hostel No 2	143	112	131
3	Hostel No 3	189	132	160
Boys Hostel				
1	Junior Gents Hostel-3	74	57	66
2	Junior Gents Hostel-2	102	71	87
4	PG2	83	61	72
NRI A				
1	Ground Floor	76	51	63
2	1st Floor	90	55	73
3	2nd Floor	84	50	70
4	3rd Floor	85	60	72
NRI B				
1	Ground Floor	110	73	93
2	1st Floor	119	89	107
3	2nd Floor	110	56	82
4	3rd Floor	137	78	103

Observations:

- The illumination level is generally as per the norms; however, illumination level is low at some places.
- The lamps have been strategically located to optimize usage of day light.
- The use of daylight has been maximized through windows.
- The practice of switching off the lamps in the unoccupied areas has been followed.
- There is no major improvements/saving potential in this area.

Ventilation & Air Quality:

The air quality was checked by measuring carbon dioxide & VOC contents at various locations in the class rooms as well as administrative areas. The details are as under.

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Central Library							
Ground Floor							
1	Post Graduate Section	131	127	129	470	457	463
2	Under Graduate Section	128	125	126	459	450	454
3	Library Entrance	130	125	127	475	450	460
4	Library Cabin	127	125	126	455	450	452
First Floor							
1	Reading Room	135	125	130	483	450	468
Second Floor							
1	UG-Reading Hall 1	128	125	127	460	450	456
2	PG-Reading Hall	177	176	176	637	633	635
3	UG-Reading Hall 3	130	128	129	467	460	463
4	Digital Library	185	125	147	667	450	524
5	Stock Room	135	125	130	465	450	455
Physiology							
Ground Floor							
1	Department Library Seminar Room	185	123	147	450	401	429
2	Demonstration Room-1	216	187	198	714	680	702
3	Assistant Professor	346	329	340	1268	1188	1216
4	Associate Professor-1	247	223	234	891	806	837
5	Associate Professor-2	206	183	195	723	660	689
6	Associate Professor-3	157	134	145	517	485	500
7	Associate Professor-4	220	200	209	720	657	690
8	Professor and HOD Cabin	185	125	147	450	401	429
9	Demonstration Room-2	193	127	164	701	620	664
10	Associate Professor-5	125	121	124	450	444	447
11	Associate Professor-6	185	124	147	450	401	429
12	Associate Professor-7	125	121	124	450	444	447
13	Associate Professor-8	185	123	147	450	401	429
14	Associate Professor-9	216	187	198	714	680	702
15	Research Lab	346	329	340	1268	1188	1216
16	Human Clinical Lab	247	223	234	891	806	837
17	Department Library Seminar Lab	206	183	195	723	660	689
18	Demonstration Room-3	157	134	145	517	485	500
19	Department Office	226	173	203	677	624	647
20	Practical Class	193	161	178	647	580	610
21	Laboratory Room	256	203	228	817	743	786
22	Associate Professor-10	208	165	188	771	701	734
23	Associate Professor-11	125	121	124	450	444	447

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Physiology							
First Floor-Forensic Department							
1	Research Lab	219	170	197	677	612	639
2	Department Library Seminar Room	188	150	171	619	540	581
3	Edmund Lockard's Museum	249	205	225	789	748	769
4	Hematology Lab	289	230	258	871	820	847
5	Amphibian Lab	277	221	248	887	800	832
6	Mammalian Lab	254	199	226	789	718	753
7	Department Office	189	145	163	592	520	557
8	Assistant HOD	177	145	158	547	520	531
9	Professor and HOD Cabin	209	171	192	666	615	640
10	Demonstration Room 1	162	138	149	547	490	514
11	Associate Professor	177	138	152	532	506	522
12	Assistant Professor	211	190	202	639	629	634
13	Tutors Room	151	130	141	482	460	471
14	Demonstration Room 2	168	145	155	542	526	534
15	Forensic Serology Lab	156	141	151	526	510	516
16	JP Modi Practical Hall	217	188	200	702	690	698
Pathology							
Ground Floor							
1	Department Office	302	256	278	981	925	952
2	Demo Room 1	366	316	338	851	812	836
3	Practical Room	272	228	247	733	690	712
4	Preparation Room	210	191	202	650	633	643
5	Histopathology Lab	436	406	424	977	960	969
6	Associate Professor 1	185	170	177	530	519	525
7	Non-Teaching Room	240	219	228	795	780	787
8	Lecture Theatre	192	165	179	647	621	633
9	Associate Professor 2	143	125	133	480	463	473
10	Associate Professor 3	163	150	157	471	455	464
First Floor							
1	Preparation and Balance Room	225	208	216	666	650	657
2	Library & Seminar Room	175	162	169	637	621	629
3	Practical Lab Clinical Path/Hematology	295	280	288	715	701	707
3	Research Lab Assistant Professor 1	351	327	338	832	812	823
4	Research Lab Assistant Professor 2	336	312	323	802	789	797
5	Tutors Room	195	178	185	672	650	662
6	Museum	167	150	158	566	545	558
Pharmacology							
Ground Floor							
1	Research Lab	436	406	424	977	960	969
2	Office	268	232	252	857	841	849
3	Asst Prof/Lecturer	215	199	208	845	830	835
4	Professor and HOD Cabin	232	211	222	782	765	773
5	Demo Room 1	223	210	218	775	757	765

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Pharmacology							
Ground Floor							
6	Experimental Pharmacology Lab	269	246	258	912	889	900
7	Preparation Room 1	253	232	243	832	815	823
8	Asst Prof 1	213	190	201	740	715	729
9	Asst Prof 2	227	203	215	806	788	798
First Floor							
1	Tutors Room	261	246	255	792	777	785
2	Museum	247	217	229	793	756	777
3	Demo Room 2	2069	187	570	699	672	685
4	Seminar Room	277	250	266	913	890	900
5	Clinical Pharmacy and Lab	266	237	251	888	856	868
6	Preparation Room	253	232	243	833	815	823
Microbiology							
Ground Floor							
1	Lecture Hall G2	237	202	218	647	613	635
2	David Bruce Lecture Hall	406	383	395	782	752	768
3	Department Office	201	177	190	663	633	647
4	HOD Office	179	160	168	640	620	630
5	Non-Teaching staff Room	347	315	331	809	787	799
6	Anatomy Demo Room 1	346	313	332	841	817	827
7	Anatomy Demo Room 2	308	283	296	619	588	604
8	Division of Human Genetics	369	351	359	777	754	766
9	Staff Room Junior	313	291	302	704	682	695
10	Lecture Hall G3	402	385	393	693	661	675
11	Dhanwanatri Hall Museum	227	217	222	691	668	682
12	Preparation Room	250	241	246	641	621	632
12	Modeler's Room	267	250	257	612	590	602
First Floor							
1	State Reference Lab for HIV Testing	482	459	470	829	801	815
2	Tutor 2	483	451	467	869	850	859
3	State Reference Lab	178	145	159	547	520	531
4	Tutor-3	209	171	192	666	615	640
5	Library/Seminar	333	317	325	845	823	833
6	Media Preparation & Storage	306	287	297	681	661	672
7	Autoclaving	347	330	336	647	623	638
8	Lecturer	356	344	349	636	612	626

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Microbiology							
First Floor							
9	Demo Hall 1	259	238	249	603	570	587
10	Professor 1	191	179	185	515	490	503
11	Professor 2	220	201	209	485	469	476
12	Asst Professor	190	171	180	509	489	498
13	Demo Hall 2	272	246	262	632	604	622
14	Grams Practical Hall	356	335	347	789	759	772
15	Preparation Room	315	289	299	730	713	722
16	Robert Koch's Museum	188	167	176	470	451	459
17	PG Research Lab	365	340	354	712	689	698
18	Assoc Professor 1	265	233	247	656	638	647
19	Assoc Professor 2	230	204	218	583	557	571
20	Bacteriology	369	348	358	833	813	823
21	Serology	326	304	315	826	796	809
22	Immunology	417	389	404	766	740	753
23	Parasitology	333	317	325	845	823	832
24	Mycology	417	389	405	618	588	604
25	Mycobacteriology	465	424	443	842	821	832
Basement							
1	Sushruther/Dissection Hall	189	174	180	513	490	502
2	Category Department	196	162	180	691	596	624
3	Histological Practical Hall UG	271	244	260	617	588	599
4	Preparation Room	179	151	165	503	470	485
5	Demo Room 1	233	215	223	565	523	541
6	Department Library, Seminar Hall	143	125	134	440	409	421
7	Staff, Senior Asst Prof 1	396	378	387	561	540	551
8	Staff, Senior Asst Prof 2	420	400	408	595	578	587
9	Staff, Senior Asst Prof 3	391	372	381	528	510	519
10	Staff, Senior Asst Prof 4	430	410	420	615	599	605
11	Senior Staff Cabin Corridor	271	250	262	541	496	520
12	Cadaver Lab	178	162	169	464	442	452
13	College Council Hall	471	449	460	786	759	773
14	Office	471	454	464	732	702	716
15	Xerox Machine Room	467	444	455	751	735	742
16	Principal Cabin, Waiting Room	320	293	307	678	655	668
17	Principal Cabin	518	492	505	868	843	856
Hospital							
Ground Floor							
1	OPD Medicine	271	250	262	541	496	520
2	Demo Room	143	125	134	440	409	421
3	OPD Surgery	346	313	332	841	817	827
4	Coffee Shop	313	291	302	704	682	695
5	OPD Obstetrics	402	385	393	693	661	675

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Hospital							
Ground Floor							
6	Gynecology & F.W.	238	217	225	691	668	682
7	Gynae Exam Room	250	241	246	641	621	632
8	Office	267	250	257	612	590	602
9	PNC Ward	346	329	340	997	963	982
10	Ground Floor Passage	247	223	234	891	806	837
11	Cash Counter	206	183	195	723	660	689
12	Obstetrics & Gynecology Obstetric Ward	278	254	267	517	485	500
13	Department of Emergency Medicine	226	173	203	677	624	647
14	Casualty Room	193	161	178	647	580	610
15	Department of Radio Diagnosis & Imaging Sciences	256	203	228	817	743	786
16	High Risk Obstetric Clinic	208	165	188	771	701	734
17	Department of Radiology & Imaging	125	121	124	450	444	447
18	Color Doppler MRI & CT Scan	302	256	278	981	925	952
19	Assistant Superintendent	366	316	338	851	812	836
20	Drugs Store-1	272	228	247	733	690	712
21	Central Pathology Lab	249	198	213	650	633	643
22	Clinical Biochemical Lab	191	179	185	515	490	503
23	Respiratory Medicine-1	220	201	209	485	469	476
24	Respiratory Medicine-2	190	171	180	509	489	498
25	Respiratory Medicine-3	272	242	261	632	604	622
26	Microbiology Lab	356	329	346	789	759	772
27	Drugs Store-2	315	289	299	730	713	722
28	Empanelment Office	188	167	176	470	451	459
29	ICTC Centre	365	340	354	712	689	698
30	OPD Dermatology, Venerology & Leprosy	265	233	247	656	638	647
31	Blood Bank	230	204	218	583	557	571
32	OPD Ear, Nose & Throat	369	348	358	833	813	823
33	OPD Orthopedics	326	304	315	826	796	809
34	OPD Pediatrics	417	389	404	766	740	753
35	OPD Eye	482	459	470	829	801	815
36	Physiotherapy Centre	483	451	467	869	850	859
37	Male Orthopedic Ward-1	333	317	325	845	823	833
38	Male Orthopedic Ward-2	306	287	297	681	661	672
First Floor							
1	Old K Block	143	125	133	480	463	473
2	Old J Block	163	150	157	471	455	464
3	Kaveri Ward	144	125	136	481	463	474
4	Boys Common Room	366	316	338	851	813	836
5	NICU	272	228	247	733	690	712
6	Dental M-Block	249	199	213	650	634	643
7	O.T.Complex	191	179	185	515	491	504
8	Medical Superintendent	220	201	209	485	469	476

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Hospital							
First Floor							
9	Principal Office	190	171	179	509	490	498
10	Nursing Superintendent	189	174	180	513	490	502
11	SICU	196	162	180	691	596	624
12	Post-Operative Ward	271	244	260	617	588	599
13	Female Surgical Ward	179	151	165	503	470	485
14	O.B.G Department	233	215	223	565	523	541
15	Male Surgical-1	143	125	134	440	409	421
16	Male Surgical-2	143	125	133	480	463	474
17	Critical Care Ward	163	151	157	471	455	465
Second Floor							
1	Male Medical Ward-1	157	134	146	517	485	500
2	Male Medical Ward-2	220	203	211	720	657	690
3	Pediatrics Department	185	125	148	450	401	429
4	Female Medicinal Ward	193	127	164	701	620	664
5	Chest & TB ward	125	121	124	450	444	447
6	Dialysis Unit	185	124	147	450	401	429
7	Medical Illustration	125	121	124	450	444	447
8	Medical Education	185	123	147	450	401	429
9	Ortho Department	216	187	198	714	680	702
10	Boys Common Room	249	229	241	923	888	907
11	Record Room	247	223	234	891	806	837
12	Lecture Hall-1	206	183	195	723	660	689
13	Museum	157	134	145	517	485	500
14	Medicine Community Department	125	121	124	450	444	447
15	Drug Store	185	123	147	450	401	429
16	Department of Otorhinolaryngology	216	187	198	714	680	702
17	Research Unit	346	329	340	828	788	808
18	Dermatology Ward	247	223	234	891	806	837
19	Department of Medicine	206	183	195	723	660	689
20	Department of Ophthalmology Surgery, Dermatology, Venerology & Leprosy	157	134	146	517	485	500
21	Passage	226	173	203	677	624	647
Third Floor							
1	Institute	185	124	147	450	401	429
2	Pediatric Ward	216	187	198	714	680	702
3	NICU Unit	347	329	340	924	888	907
4	PICU Unit	247	223	234	891	806	837
5	Female Skin Ward	206	183	195	723	660	689
6	Male Skin Ward	157	134	146	517	485	500
7	Post-Operative Ward	220	203	211	720	657	690
8	Critical Care Unit	185	125	148	450	401	429
9	Post Anesthetic Care Unit	193	129	164	701	620	664
10	Deputy Medical Superintendent	125	121	123	450	444	447

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Hospital							
Third Floor							
11	Drug Store Passage	185	124	147	450	401	429
12	Drug Store	201	178	190	663	633	647
13	Pre Operation Theatre	179	161	169	640	620	630
14	Operation Theatre-1	347	317	332	809	787	799
15	Operation Theatre-2	346	311	332	841	817	827
16	Operation Theatre-3	308	283	296	619	588	604
17	Operation Theatre-4	369	349	358	777	754	766
18	Operation Theatre-5	313	291	302	704	682	695
19	M Block-3	192	165	179	647	621	633
20	Burn Ward	143	125	133	480	463	473
21	J Block	163	150	157	471	455	464
22	K Block	161	134	148	540	496	511
Admin Building (Deemed to be University)							
Ground Floor							
1	Waiting Lounge	185	124	147	450	401	429
2	Information Cell	201	178	190	663	633	647
3	Finance Section	179	161	169	640	620	630
4	Academic Section	347	317	332	809	787	799
5	Store Room	346	311	332	841	817	827
6	Deputy Registrar	308	283	296	619	588	604
7	Professor J.G. Ambekar Registrar	369	349	358	777	754	766
8	Ground Floor Passage	313	291	302	704	682	695
9	Registrar Office	192	165	179	647	621	633
10	Waiting Room	143	125	133	480	463	473
11	Reception Area	163	150	157	471	455	464
First Floor							
1	Dean Research & Development	259	238	249	603	570	587
2	Dr.M.B.Patil Chancellor & Board Room	191	179	185	515	490	503
3	Vice Chancellor	220	201	209	485	469	476
4	1st floor passage	250	241	246	641	621	632
Second Floor							
1	Internal Quality Assurance Cell	356	335	347	789	759	772
2	COE Office	185	123	147	450	401	429
3	NAD Cell Officer	268	232	252	857	841	849
4	Supporting Staff Computer	347	317	332	809	787	799
5	Server Section	346	311	332	841	817	827
6	Dr.S.S.M controller of Examination	215	199	208	845	830	835
7	Moderators Room	232	211	222	782	765	773
8	Vice Principal Cabin	143	125	134	440	409	421
Construction							
1	Entry passage	191	179	185	515	491	504
2	Resident Engineer Cabin	220	201	209	485	469	476
3	U.N.Karadi Cabin	190	171	179	509	490	498

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
Halkatti Bhavan(New Building)							
1	Library	272	228	247	733	690	712
2	Meeting Hall	210	191	202	650	633	643
3	Office	436	406	424	977	960	969
Halkatti Bhavan(Old Building)							
1	1st Floor	144	125	136	481	463	474
2	2nd Floor	366	316	338	851	813	836
Printing Room							
1	Room No. 1	436	406	424	977	960	969
2	Room No. 2	185	170	177	530	519	525
3	Room No. 3	240	219	228	795	780	787
4	Room No. 4	192	165	179	647	621	633
Gymnasium							
1	Gym	369	349	358	777	754	766
Central Animal House							
1	Rest Room	143	126	134	440	409	421
2	Rats	143	125	133	480	463	474
3	Quarantine	163	152	158	471	455	465
4	Mice	190	171	180	509	490	498
5	Store Room	189	171	179	513	490	502
6	Rabbits	196	169	181	691	596	624
7	Operation Theatre	157	134	146	517	485	500
8	Guinea Pigs	126	121	124	450	444	447
9	Office-1	185	121	147	450	401	429
10	Office-2	201	160	184	714	680	702
NRI Guest House							
Ground Floor							
1	Room No 4	396	378	387	561	540	551
2	Room No 5	420	400	408	595	578	587
3	Room No 6	391	372	381	528	510	519
4	Room No 7	430	410	420	615	599	605
5	Room No 8	271	250	262	541	496	520
6	Room No 9	185	123	147	450	401	429
7	Conference Hall	422	403	412	963	945	954
First Floor							
1	Room No 1	240	219	228	795	780	787
2	Room No 2	272	228	247	733	690	712
3	Room No 3	210	191	202	650	633	643
4	Conference Hall	436	406	424	977	960	969
5	Dining Hall	213	193	203	652	635	644
Second Floor							
1	Room No 10	163	150	157	471	455	464
2	Room No 11	144	125	136	481	463	474
3	Room No 12	366	316	338	851	813	836
4	Room No 13	272	228	247	733	690	712

Sr No	Location	Volatile Organic Compound (PPB)			Carbon Dioxide (PPM)		
		Max	Min	Avg	Max	Min	Avg
NRI Guest House							
Second Floor							
5	Room No 14	249	199	213	650	634	643
6	Room No 15	191	179	185	515	491	504
Ladies Hostel							
1	Hostel No 1	232	211	222	782	765	773
2	Hostel No 2	223	210	218	775	757	765
3	Hostel No 3	269	246	258	912	889	900
Boys Hostel							
1	Junior Gents Hostel-3	238	217	225	691	668	682
2	Junior Gents Hostel-2	250	241	246	641	621	632
4	PG2	346	329	340	997	963	982
NRI A Hostel							
1	Ground Floor	249	229	241	923	888	907
2	1st Floor	247	223	234	891	806	837
3	2nd Floor	206	183	195	723	660	689
4	3rd Floor	157	134	145	517	485	500
NRI B Hostel							
1	Ground Floor	185	124	147	450	401	429
2	1st Floor	201	178	190	663	633	647
3	2nd Floor	179	161	169	640	620	630
4	3rd Floor	347	317	332	809	787	799

Observations:

- The carbon dioxide and VOC level are within the limit at most of the places. The standard norm is to maintain the carbon dioxide level below 1000 ppm & VOC level below 400 ppb.
- The ventilation / fresh air intake may be increased wherever the levels are above the prescribed values.

Chapter - V
Water Management

Consumption Pattern:

The water supplied by the municipal corporation is used for drinking & other applications like toilets, washing of utensils and other requirements. The incoming water from the municipal corporation is metered.

The consumption pattern was analyzed by the water bills.

The details are as under.

Month	Consumption	Cost	
	KL	Rs	Rs/ KL
56310715 (Principal Medical College BLDE Association)			
Apr-19	6090	166238	27.3
May-19	1540	41886	27.2
Jun-19	376	10074	26.8
Jul-19	920	24395	26.5
73973 (Staff Quarters Hostel BLDE)			
Apr-19	488	13135	26.9
May-19	506	13627	26.9
Sep-19	401	13490	33.6
Oct-19	483	12998	26.9
Nov-19	743	20104	27.1
Dec-19	730	19749	27.1
15050060 (Head Construction and Maintenance Cell)			
July	5086	138798	27.3

Specific Water Consumption:

The specific water consumption cannot be computed as only municipal water connection has been metered; while the water from other sources including various borewells is also utilized for non-potable applications. The possibility of metering borewell water may also be assessed.

There are around 3284 students and around 1319 teaching & non-teaching staff and other Visitor members.

The possibility of providing low flow taps/flushing system at major locations may also be evaluated.

Water Purifiers:

The RO plants are in operation within the premises building wise and bottled water is not used in the campus.

Rain Water Harvesting:

The yearly rain fall in the area like Vijayapura is very less, still the rain water harvesting projects with feasible economics may be implemented in near future.

While for any future development may be considered the rain water harvesting project at the pre-development stage.

Chapter - VI
Waste Generation & Management

Sewage & Waste Water:

The sewage water is treated in the sewage treatment plant; while the other water is treated in the effluent treatment plant. The treated effluent is discharged and disposed through the Municipal system. The STP water is recycle and used for garden areas in the premises; which is good practice in area like Vijayapura.

The possibility of further treating the water and utilizing the treated water for all non-potable usages may also be assessed.

Solid Waste:

The awareness programs have been initiated for domestic solid waste management where the domestic solid waste is disposed through Municipal system. It is suggested to incorporate solid waste management system. The organic solid waste may be segregated and fed to biogas to generate biogas & manure and / or composting pit to prepare manure. While the biogas can be consumed in canteen the manure can be utilized for gardening. The other waste can be segregated in paper, metal, plastic and recycled / reused. However, an initiative has been taken placed to by constructing a composting pit for plant leaves. Which may be extended for other organic waste.

An initiative has been taken placed to segregate the organic and non-organic waste in the premises. Domestic waste is disposed of through Municipal system.

The possibility of installing biogas plant from plate and canteen waste is could be initiate.

Biomedical Waste:

The biomedical waste is segregated in to three categories i.e. yellow, blue and red. The yellow (Highly Hazardous) category waste disposed of through an incinerator while the others are properly sterilized and disposed through the municipal system. The below image shows the segregated biomedical waste

E-Waste:

Electronic waste submitted for recycling / disposing to an E-waste Management Organization.

Chapter - VII
Infrastructure & Safety

Movement on-campus (Distributed / non-distributed leading to crowds)

The premises are provided with multiple entrances to ensure quick and effective movement in normal as well as emergency conditions.

Automobile movement in the campus is regulated. There are total three E- Vehicles in the campus, while they have been using one E- vehicles for student and staff transportation, and other two for the cargo transportation.

Parking space:

The adequate parking space is available and provisions are made for car vehicle parking.

Fire-fighting & fire escape system:

The fire extinguishers have been installed at various places in the premises & Laboratories; which are checked/refilled as per the stipulated frequency.

A total of 303 fire extinguishers have been placed in the campus. The hospital premises are also provided with fire hydrant system with 1035 number of detectors and 57 number of hooters

The premise is provided with requisite entrances to ensure quick and effective movement in emergency conditions. Electrical safety and fire safety programs have been conducted throughout the academic year.

Draining system:

The drains from the washrooms are connected to the sewage treatment plant.

Seepage in the building:

The premise was visually inspected for seepages. Seepages were observed at a few places in the building premises, which may be remedied.

Future Developments :

For future development may be considered the higher energy efficient equipment's e.g. BEE High star (5 star) rated ACs, IE4 motors , energy efficient fans etc.

The window glass may be selected with lower solar gain coefficient glass for lower heat transfer through the glass**.**

Green Plantation:

The campus is well covered with green plants, the details are as under,

Sr No	Name of the Plant	Quantity (No.)
1	Azadirachtn Indica	1200
2	Albizziajulibrissin Mix Plants	120
3	Araucaria Cook 2	20
4	Bauhinia Blakean	250
5	Cassia Fistula	35
6	Callistemon Citrinus	30
7	Cassia Grandis	35
8	Cycas Circinalis	20
9	Delonix Elata	150
10	Hibiscus Tiliaceus	180
11	Ficus Bengalensis(Mix Variety)	300
12	Jacaranda Filicifolia	125
13	Lagerstroemia Rosea	180

Sr No	Name of the Plant	Quantity (No.)
14	Michelia Champaca	75
15	Muntingia Calabura	80
16	Markhamia Platycalyx	80
17	Nyctanthes Arbor Tristis	354
18	Peltophorum Africanum	250
19	Plumeria Lutea	50
20	Podocarpus Elongata	150
21	Polyalthia Longifolia	350
22	Pongamia Pinnata	220
23	Samanea Saman	50
24	Ravenala Madagacariensis	10
25	Royal Pam	80
26	Arika Pam	100
27	Spathodea Campanulata	350
28	Tabebuia Argentea	250
29	Teriminalia Catappa	80
30	Cherry	80
31	Gagana Mallige	180
32	Thuja Orientalis	30
33	Mango Trees	80
34	Tamarind Trees	20
35	Jamun Trees	50
36	Sandal Wood Trees	25
37	Custard Apple	210
38	Ilachi Trees	60
39	Arali Mara	80
40	Sirsan Tree	30
41	Nilagiri	30
42	Coconut	10
43	Chickku	10
44	Nuggi	10
45	Cashibina Mix Flowers	250
46	Mentali Trees	80
47	Golden Saifusrs	120
48	Peru Tree	10

There are around 48 different species of trees, shrubs and bushy plants covered inside the campus, below image shows the one of the green covered area inside the premises.

Chapter - VIII
Air Conditioners

Air conditioning system is basically provided to maintain comfortable ambience inside the premises by maintaining the temperature (and relative humidity, at times) at appropriate levels. The performance of human being is optimal at the temperature of 24 ± 2 ^{o}C and at relative humidity (RH) of 60 ± 5%.

The warmer and humid air from the premises is drawn and fed to the Air Conditioning System by a circulating fan. This air is chilled in an evaporator by vaporizing the refrigerant and is distributed throughout the conditioned area. The refrigerant is pressurized by a compressor and subsequently s cooled and condensed by an air-cooled condenser. The compressor and condenser are placed in an outdoor unit, located on the external side of the premise. While the circulating fan and evaporator are placed in an indoor unit located inside the premises.

Performance:

The performance as well as chilling (or Air Conditioning) effect delivered by the air conditioner (represented as TR – Ton of Refrigeration) is computed by measuring

- Air Velocity along with the cross-sectional area of flow to determine the flow rate and subsequently mass flow rate.
- Temperature and relative humidity of the air at the inlet of the evaporator coil to determine the enthalpy of the air.
- Temperature and relative humidity of the air at the outlet of the evaporator coil to determine the enthalpy of the air.
- Power drawn by the air conditioning unit

The chilling effect can be computed as under,

Flow Rate of Air (kg/hr)
= Average Air velocity (M/s) x Cross sectional area of the air flow (M^2) x Specific Gravity of Air

Chilling or Air Conditioning Effect (TR)
= Air flow rate (kg/hr) x Enthalpy difference between the air at inlet & outlet of the evaporator coil (kJ/kg) / (4.18 x 3024)

Chilling or Air Conditioning Effect (kW)
= Air flow rate (kg/hr) x Enthalpy difference between the air at inlet & outlet of the evaporator coil (kJ/kg) / 3600
= 3.5112 x Chilling Effect (TR)

Specific Power Consumption (kWh/TR) =
Power consumption (kW) / Air Chilling Effect (TR)

Energy Efficiency Ratio – EER (W of cooling / W of input power)
= Power consumption (kW) / Air Chilling Effect (kW)
= 3.5112 / Specific Power consumption (kW/TR)

The performance of a few of the randomly selected air conditioning units (of different make, capacity and age) were carried out as described above.

Description	Unit	Direct- AHUs			
		Third Floor		First Floor	
		ICU A Side	ICU B Side	ICU A Side	ICU B Side
Design Parameters					
Make		Zeco Aircon	Zeco Aircon	Zeco Aircon	Zeco Aircon
Rating (Capacity)	TR	17.5	17.5	17.5	11.0
Actual parameters					
Operation	Hr/D	24	24	24	24
	D/Y	365	365	365	365
Indoor Unit					
Supply air - Temp	°C	16.7	16.5	17.2	19.5
Supply air - RH	%	64	64	64	61
Return air - Temp	°C	24.6	24.9	24.9	25.5
Return air - RH	%	43	43	42	41
Velocity	M/s	4.5	4.3	5.2	5.6
Area	M^2	1.00	1.00	1.00	1.00
Air flow - Supply	M^3/Sec	4.500	4.300	5.200	5.600
Supply Enthalpy	kJ/kg	36.0	35.6	37.1	41.5
Return Enthalpy	kJ/kg	45.9	46.6	46.1	46.9
Enthalpy drop	kJ/hr	194978.7	206302.1	203318.4	131671.3
	TR	15.40	16.30	16.06	10.40
Fan Power	kW	5.7	5.4	3.8	4.8
Key parameter					
AC Output	TR	17.02	17.83	17.14	11.77
	% Rated	97%	102%	98%	107%
Power	kW	19.0	21.6	21.7	14.5
Specific Power	kWh/TR	1.12	1.21	1.27	1.23
E R		3.15	2.90	2.77	2.85
Hall Temperature					
Maximum	°C	24.5	24.0	24.5	24.0
Minimum	°C	23.0	22.0	23.0	22.0
Average	°C	24.2	24.2	24.2	24.2
Variation - Room	°C	1.5	2.0	1.5	2.0
	%	6.2%	8.3%	6.2%	8.3%

Observations:

- The performance of all the AC machines is satisfactory.
- The temperatures are maintained as per the stipulated norms and variation across the room is marginal.

Description	Unit	Direct - AHUs					
		OT 1	OT 2	OT 3	OT 4	OT 5	Corridor 2
Design Parameters							
Make		Zeco Aircon	Zeco Aircon	Zeco Aircon	Zeco Aircon	Zeco Aircon	Zeco Aircon
Rating (Capacity)	TR	11.0	11.0	11.0	11.0	11.0	8.8
Actual parameters							
Operation	Hr/D	24	24	24	24	24	24
	D/Y	365	365	365	365	365	365
Indoor Unit							
Supply air - Temp	°C	19.3	18.3	18.2	19.8	18.2	16.7
Supply air - RH	%	64	65	64	61	64	64
Return air - Temp	°C	25.9	24.1	24.5	25.7	24.4	25.9
Return air - RH	%	40	42	42	40	44	39
Velocity	M/s	8.8	8.3	8.7	10.7	7.6	3.5
Area	M^2	0.65	0.65	0.65	0.65	0.65	0.500
Air flow - Supply	M^3/Sec	5.718	5.393	5.653	6.953	4.938	1.750
Supply Enthalpy	kJ/kg	42.2	40.0	39.6	42.2	39.4	36.0
Return Enthalpy	kJ/kg	47.3	44.2	45.1	46.8	45.9	46.8
Enthalpy drop	kJ/hr	126613.7	100861.6	137129.7	139363.3	138977.2	82711.6
	TR	10.00	7.97	10.83	11.01	10.98	6.53
Fan Power	kW	3.1	3.1	2.9	2.9	3.2	1.9
Key parameter							
AC Output	TR	10.88	8.85	11.65	11.83	11.89	7.06
	% Rated	99%	80%	106%	108%	108%	81%
Power	kW	13.5	11.0	14.9	15.2	14.5	8.6
Specific Power	kWh/TR	1.24	1.24	1.28	1.28	1.22	1.22
E R		2.84	2.83	2.74	2.74	2.88	2.88
Hall Temperature							
Maximum	°C	24.5	24.0	24.0	24.5	24.0	24.0
Minimum	°C	22.0	22.0	22.0	23.0	22.0	22.0
Average	°C	24.2	24.2	24.2	24.2	24.2	24.2
Variation - Room	°C	2.5	2.0	2.0	1.5	2.0	2.0
	%	10.3%	8.3%	8.3%	6.2%	8.3%	8.3%

Observations:

- The performance of all the AC machines is satisfactory.
- The temperatures are maintained as per the stipulated norms and variation across the room is marginal.

Description	Unit	Ductable AC				
		MRI				
		Technical Room	Technical Room	MRI-1	MRI-2	Reporting Room
Design Parameters						
Make		Blue Star	Blue Star	Blue Star	Blue Star	Blue Star
Rating (Capacity)	TR	8.5	5.5	5.5	5.5	5.5
Actual parameters						
Operation	Hr/D	24	24	24	24	24
	D/Y	365	365	365	365	365
Indoor Unit						
Supply air - Temp	°C	16.7	17.5	17.9	17.6	17.2
Supply air - RH	%	65	64	64	64	65
Return air - Temp	°C	24.1	24.4	24.3	24.5	24.5
Return air - RH	%	43	42	43	42	43
Velocity	M/s	4.8	2.9	2.8	2.6	2.3
Area	M^2	0.54	0.50	0.50	0.50	0.50
Air flow - Supply	M^3/Sec	2.608	1.436	1.386	1.287	1.139
Supply Enthalpy	kJ/kg	36.3	37.9	38.7	38.0	37.4
Return Enthalpy	kJ/kg	44.7	44.9	45.2	45.1	45.6
Enthalpy drop	kJ/hr	95799.2	44001.8	38963.3	39943.7	40878.8
	TR	7.57	3.48	3.08	3.16	3.23
Key parameter						
AC Output	TR	7.57	3.48	3.08	3.16	3.23
	% Rated	89%	63%	56%	57%	59%
Power	kW	10.5	3.8	3.7	3.8	3.9
Specific Power	kWh/TR	1.38	1.08	1.20	1.19	1.21
E R		2.54	3.25	2.92	2.95	2.91
Hall Temperature						
Maximum	°C	23.0	23.0	23.0	23.0	24.0
Minimum	°C	22.5	22.5	22.5	22.5	23.0
Average	°C	24.2	24.2	24.2	24.2	24.2
Variation - Room	°C	0.5	0.5	0.5	0.5	1.0
	%	2.1%	2.1%	2.1%	2.1%	4.1%

Observations:

- The performance of all the AC machines is satisfactory.
- The temperatures are maintained as per the stipulated norms and variation across the room is marginal.

Split Air conditioners:

Description	Unit	Central Library				University Building	
		PG Hall		Digital Library		COE Office	NAD Cell
		AC 2	AC 5	AC 9	AC 5	AC 1	AC 2
Design Parameters							
Make		Blue Star	Blue Star	NA	NA	NA	NA
Rating (Capacity)	TR	4.5	4.5	NA	NA	NA	NA
Star Rating		NA	NA	NA	NA	NA	NA
E E R		3.3	2.7	NA	NA	NA	NA
Power	kW	4.8	5.8	NA	NA	NA	NA
Actual parameters							
Operation	Hr/D	4	4	4	4	6	6
	D/Y	280	280	280	280	280	280
Indoor Unit							
Supply air - Temp	°C	12.3	12.2	13.2	13.1	9.3	10.1
Supply air - RH	%	76	75	76	77	71	73
Return air - Temp	°C	22	24.9	22.1	21.9	21.9	22.1
Return air - RH	%	54	43	59	55	59	58
Velocity	M/s	6.3	6.1	4.9	5.1	2.5	2.9
Area	M^2	0.10	0.10	0.06	0.06	0.05	0.05
Air flow - Supply	M^3/Sec	0.610	0.590	0.314	0.326	0.135	0.156
Supply Enthalpy	kJ/kg	29.5	29.1	31.4	31.5	22.4	24.3
Return Enthalpy	kJ/kg	44.8	46.6	47.2	45.0	46.7	46.7
Enthalpy drop	kJ/hr	41525.7	46004.3	21934.2	19477.5	14710.0	15748.8
	TR	3.28	3.63	1.73	1.54	1.16	1.24
Key parameter							
AC Output	TR	3.28	3.63	1.73	1.54	1.16	1.24
	% Rated	73%	81%				
Power	kW	3.9	3.9	1.9	1.9	1.5	1.4
Specific Power	kWh/TR	1.19	1.07	1.10	1.23	1.29	1.13
E E R		2.95	3.27	3.20	2.84	2.72	3.12
Hall Temperature							
Maximum	°C	24.5	24.0	24.5	24.0	24.5	24.0
Minimum	°C	23.0	22.0	23.0	22.0	22.0	22.0
Average	°C	24.2	24.2	24.2	24.2	24.2	24.2
Variation - Room	°C	1.5	2.0	1.5	2.0	2.5	2.0
	%	6.2%	8.3%	6.2%	8.3%	10.3%	8.3%

Description	Unit	University Building	Construction Cell	Hospital		
		Chancellor Cabin	Resident Engineer	Server Room	M Block VIP Room	Burn Ward
		AC 2		AC 1	AC 2	AC1
Design Parameters						
Make		LG	Blue star	Blue star	Blue star	Blue star
Rating (Capacity)	TR	NA	1.0	1.0	1.5	2.0
Star Rating		NA	5	3	3	NA
E E R		NA	1	NA	NA	NA
Power	kW	NA	NA	1.1	NA	NA
Actual parameters						
Operation	Hr/D	4	6	24	3	2
	D/Y	140	280	365	280	280
Indoor Unit						
Supply air - Temp	°C	12.3	18.2	10.3	11.2	11.5
Supply air - RH	%	61	64	69	70	68
Return air - Temp	°C	25.7	24.4	23.9	24.1	24.1
Return air - RH	%	42	44	48	47	48
Velocity	M/s	4.0	7.6	2.3	2.5	2.8
Area	M^2	0.06	0.05	0.05	0.07	0.07
Air flow - Supply	M^3/Sec	0.230	0.410	0.124	0.180	0.207
Supply Enthalpy	kJ/kg	26.0	39.4	23.9	25.8	26.0
Return Enthalpy	kJ/kg	47.9	45.9	46.7	46.7	47.1
Enthalpy drop	kJ/hr	22349.7	11528.0	12658.7	16738.0	19482.7
	TR	1.77	0.91	1.00	1.32	1.54
Key parameter						
AC Output	TR	1.77	0.91	1.00	1.32	1.54
	% Rated		91%	100%	88%	77%
Power	kW	2.3	1.0	1.0	1.4	2.0
Specific Power	kWh/TR	1.30	1.10	1.00	1.06	1.30
E E R		2.70	3.20	3.51	3.32	2.70
Hall Temperature						
Maximum	°C	24.5	24.0	23.0	25.0	25.0
Minimum	°C	23.0	23.0	22.0	24.0	24.0
Average	°C	24.2	24.2	24.2	24.2	24.2
Variation - Room	°C	1.5	1.0	1.0	1.0	1.0
	%	6.2%	4.1%	4.1%	4.1%	4.1%

Observations:

- The performance of all the split AC machines is more or less satisfactory.
- The temperatures are maintained as per the stipulated norms and variation across the room is marginal.

Chapter - IX
Green Culture

The power consumption of some of the electronic gadgets is as under,

Equipment	Starter	Voltage	Current	PF	Power
		V	Amps		kW
PC					
Central Library, UG Hall	DOL	242.1	0.4	0.84	0.08
Hospital, RMO PC	DOL	237.4	0.4	0.57	0.06
Hospital, Admin PC	DOL	235.9	0.3	0.88	0.07
Hospital, Cash Counter PC 7	DOL	221.1	0.1	0.52	0.02
Hospital, Cash Counter PC 2	DOL	221.9	0.1	0.54	0.02
PC Asst Registrar	DOL	228.4	0.4	0.53	0.05
Printing Press					
Auto print Machine	DOL	234.1	5.1	0.94	1.1
Printoram 164	DOL	415.6	3.9	0.56	1.6
Printer					
Hospital, Admin	DOL	235.9	1.8	0.89	0.4
Hospital, Cash Counter 2	DOL	221.9	1.9	0.88	0.4
University Bldg. Admin Printer	DOL	229.4	1.9	0.99	0.4
University Bldg. Admin Xerox m/c	DOL	229.4	2.2	0.99	0.5

Observations:

1. The LED / LCD monitors have been procured, which are energy efficient.

2. These monitors are not only energy efficient but also generate minimal heat and cut down on air conditioning load.

Recommendations:

The following steps may be initiated to further enhance efficiency of various PCs

1. An efficient power management system may be incorporated to
    a. Switch off the display if not in use.
    b. Put the computer in Sleep mode / switching off the machines, if not used for a prolonged period.

2. Optimize brightness of the screen.

3. Discourage use of screen savers, which has similar power consumption.

Paper-less communication:

The major internal, as well as external communication, is through an electronic medium.

The present consumption of A4 size papers for year 2019-2020 is around 3430 reams.

Re-using one sided paper for printing:

It was observed that two side printing/printing on the back side of the used paper in more than 80% of the cases.

Chapter - X
Solar Energy

Solar Photovoltaic - Rooftop: 248 kW:

Roof top solar photovoltaic system of 248 kW capacity has been commissioned in September 2019, where it is not wheel to the grid and only generates the electricity and use as per requirement within the premises. The details are as under,

Month	Power Generation	Specific Power
	kWh/Month	kWh/Day/kW_P
Sep-19	14064.0	1.9
Oct-19	19535.0	2.5
Dec-19	21182.0	2.8
Jan-20	25284.0	3.3

The specific power appears to be marginally lower than the typical values of 4.5 to 5 kWh/kW_P; which may be investigated and remedied. The possibility of synchronizing the system with grid with net metering may also be assessed.

Solar Photovoltaic - Ground 3.3 mW:

The ground based solar photovoltaic system of 3.3 mW capacity has been commissioned from January 2017 on the commercial basis and the annual power generation details are as under,

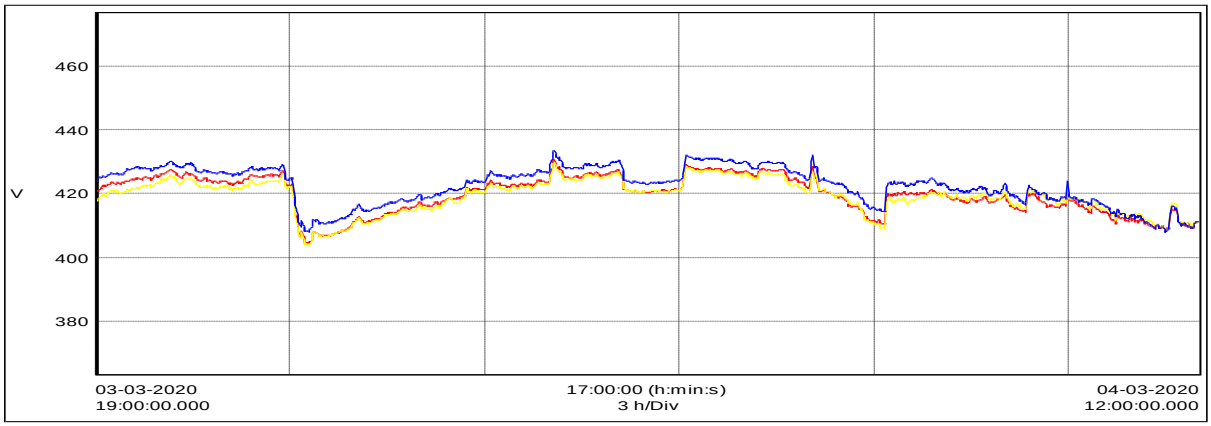
Month	Power Generation	Specific Power
	kWh/Month	kWh/Day/kW_P
Mar-19	537351.3	5.3
Apr-19	495435.3	5.0
May-19	493783.1	4.8
Jun-19	364761.0	3.7
Jul-19	318110.0	3.1
Aug-19	354142.9	3.5
Sep-19	354682.0	3.6
Oct-19	373038.6	3.6
Nov-19	437697.4	4.4
Dec-19	367575.0	3.6
Jan-20	452948.5	4.4
Feb-20	468254.3	4.9
Total	5017779.1	4.2

The values may be compared with the design values and remedied if need be.

Chapter - XI
Power Quality Analysis

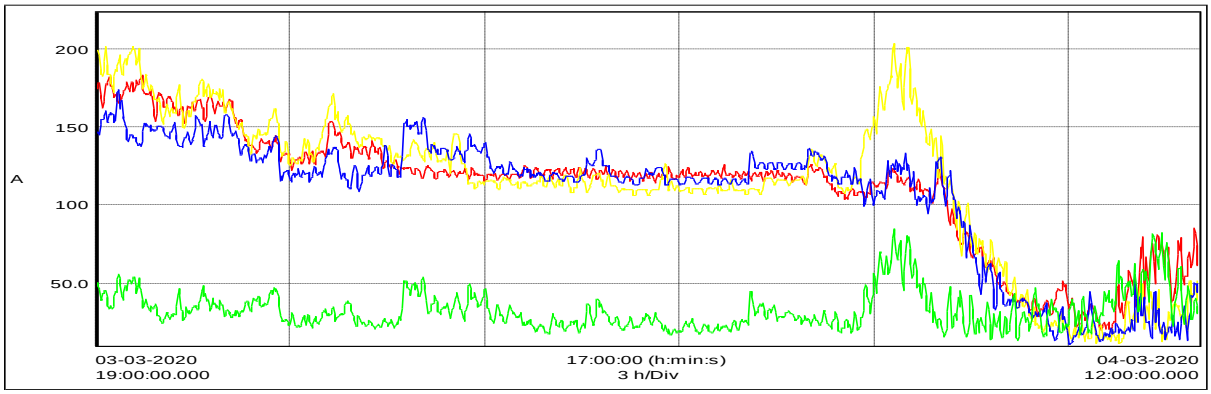
The details of power quality of the transformer are as under,

HT 76, 500 KVA:
Voltage (V):



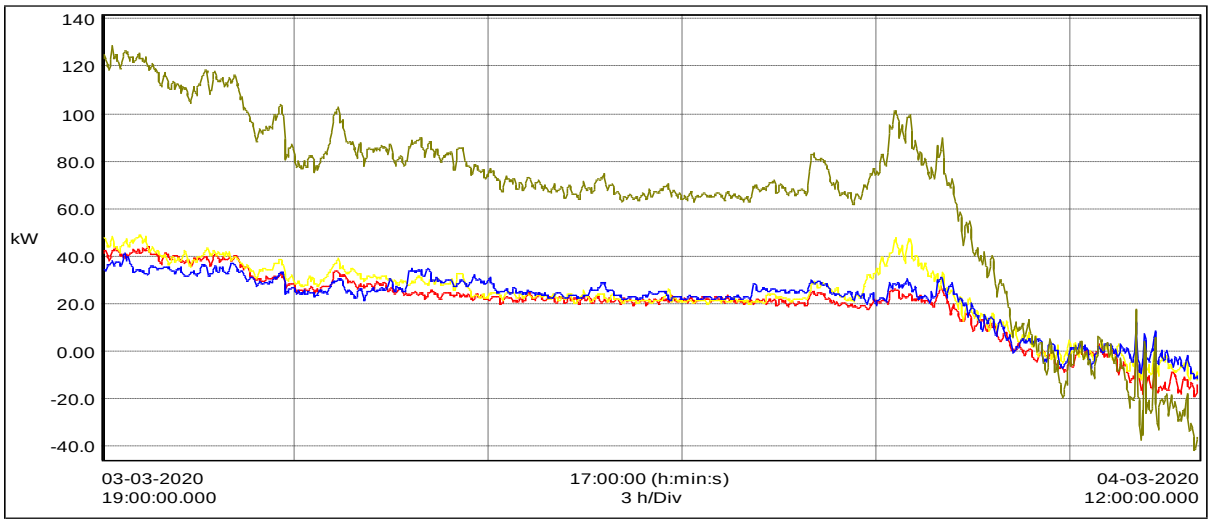
Parameter	Unit	Average	Minimum	Maximum
Voltage RY	V	419.9	404.0	432.0
Voltage YB	V	419.4	403.3	430.7
Voltage RB	V	422.6	406.8	434.6

Current (A):



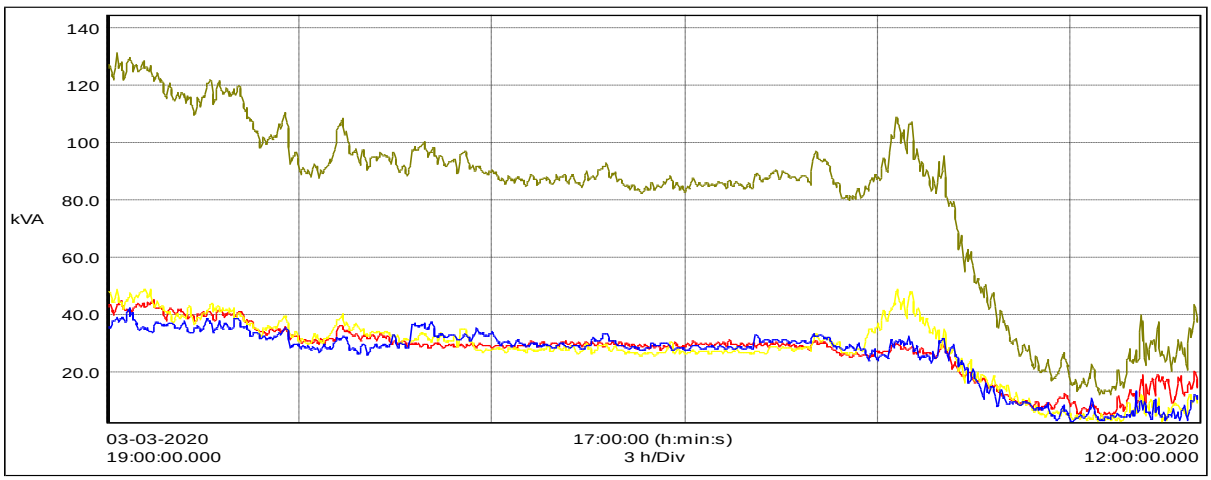
Parameter	Unit	Average	Minimum	Maximum
Current R	A	118.1	16.1	187.9
Current Y	A	123.2	10.0	209.2
Current B	A	114.5	8.0	181.9
Current N	A	35.3	11.4	98.5

Power – Real (kW):



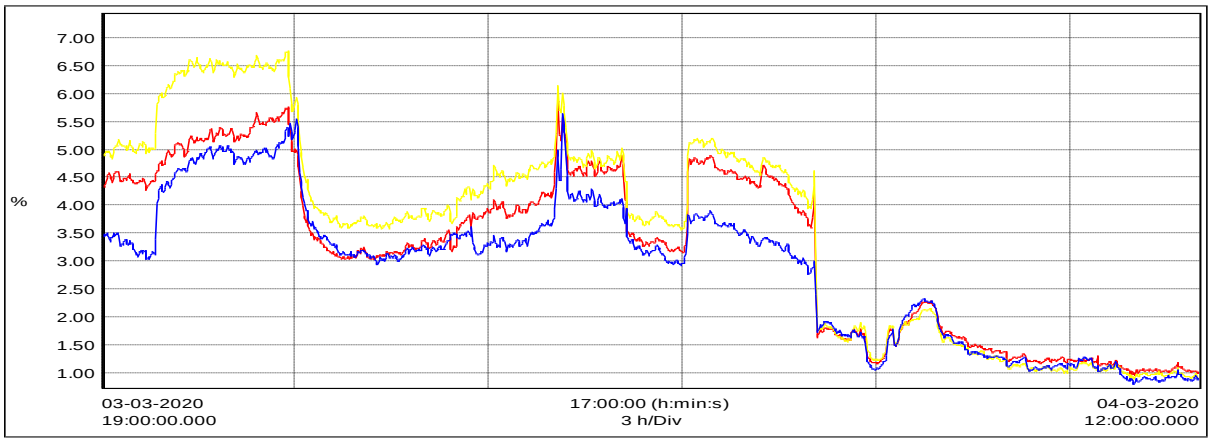
Parameter	Unit	Average	Minimum	Maximum
Active Power R	kW	19.8	-19.3	44.2
Active Power Y	kW	23.3	-12.0	48.7
Active Power B	kW	21.7	-11.7	41.2
Active Power Total	kW	64.8	-41.9	129.0

Power - Apparent (kVA):



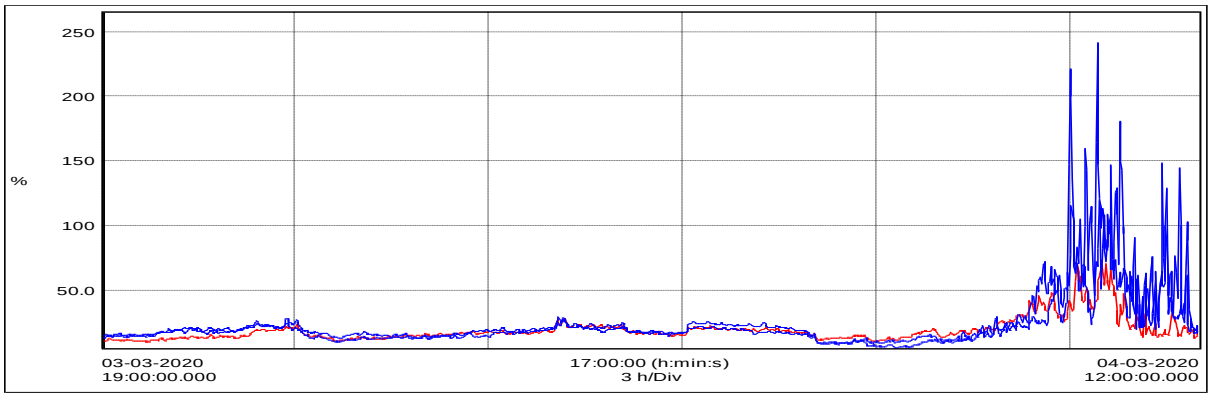
Parameter	Unit	Average	Minimum	Maximum
Apparent Power R	kVA	27.3	4.9	45.1
Apparent Power Y	kVA	27.5	2.8	49.1
Apparent Power B	kVA	26.0	2.6	42.6
Apparent Power Total	kVA	80.8	12.1	131.5

Voltage THD (%):



Parameter	Unit	Average	Minimum	Maximum
Voltage RY	%	3.2	0.9	5.9
Voltage YB	%	3.6	0.9	6.8
Voltage RB	%	2.9	0.8	5.7

Current THD (%):

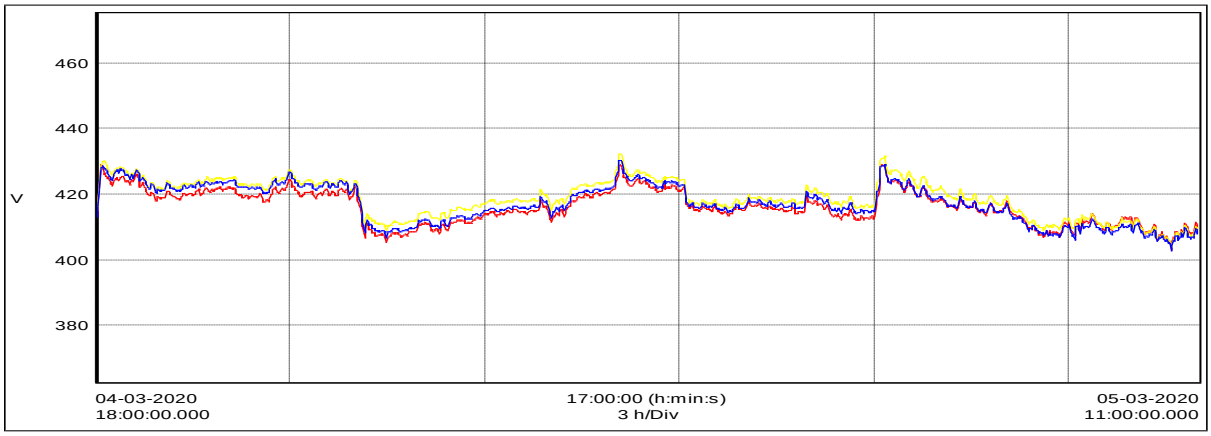


Parameter	Unit	Average	Minimum	Maximum
Current R	%	19.3	10.2	73.9
Current Y	%	24.1	5.4	241.3
Current B	%	22.7	8.7	221.3

Observations:

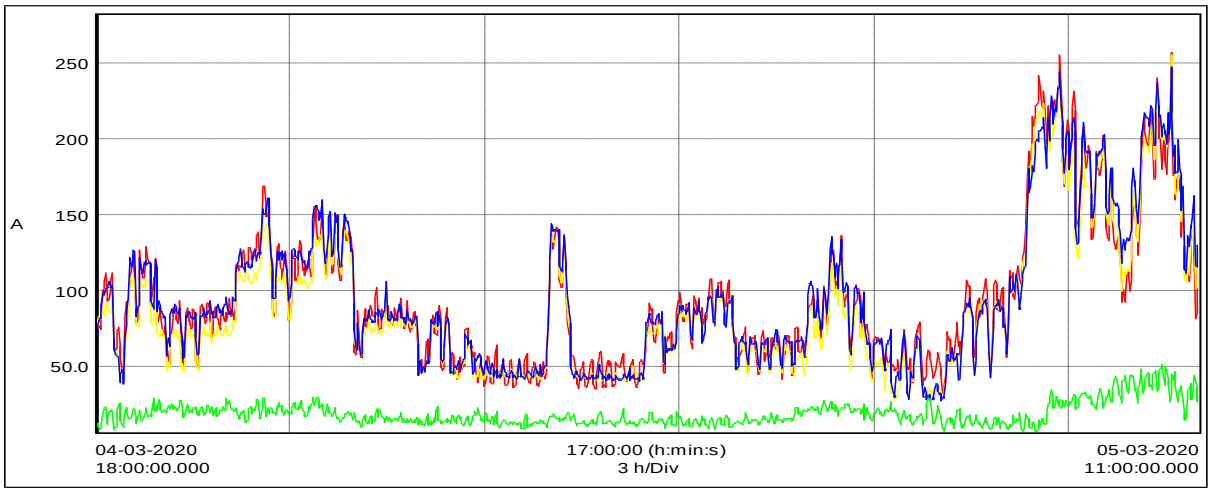
- Voltage Harmonics are within limit of 5%
- Current Harmonics are higher than the stipulated value of 5%

HT 14, New Transformer 500 KVA:
Voltage (V):



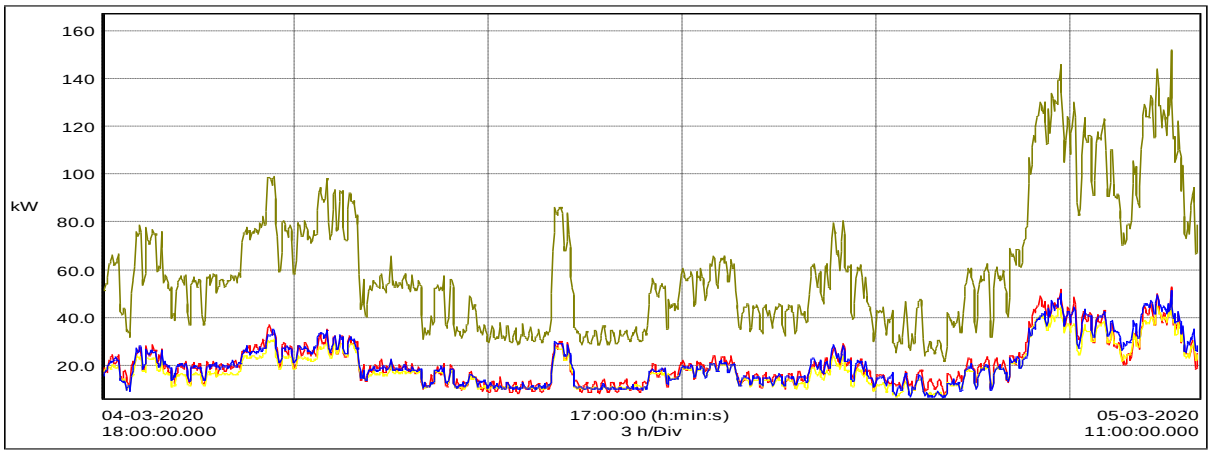
Parameter	Unit	Average	Minimum	Maximum
Voltage RY	V	416.2	401.9	430.1
Voltage YB	V	418.8	402.5	433.3
Voltage RB	V	417.2	401.3	431.3

Current (A):



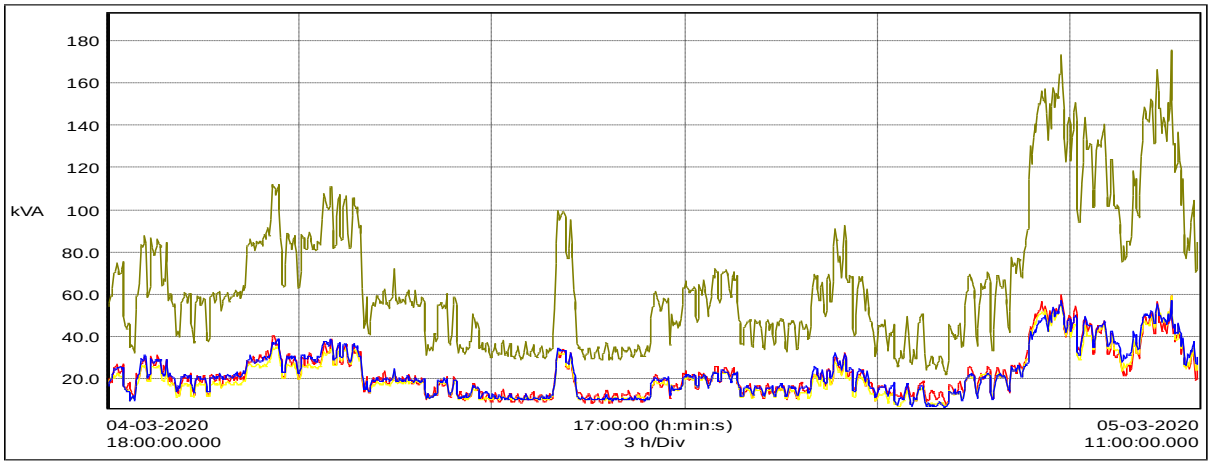
Parameter	Unit	Average	Minimum	Maximum
Current R	A	104.8	28.1	278.9
Current Y	A	99.1	24.5	279.6
Current B	A	106.0	21.0	276.8
Current N	A	20.5	6.3	57.8

Power – Real (kW):



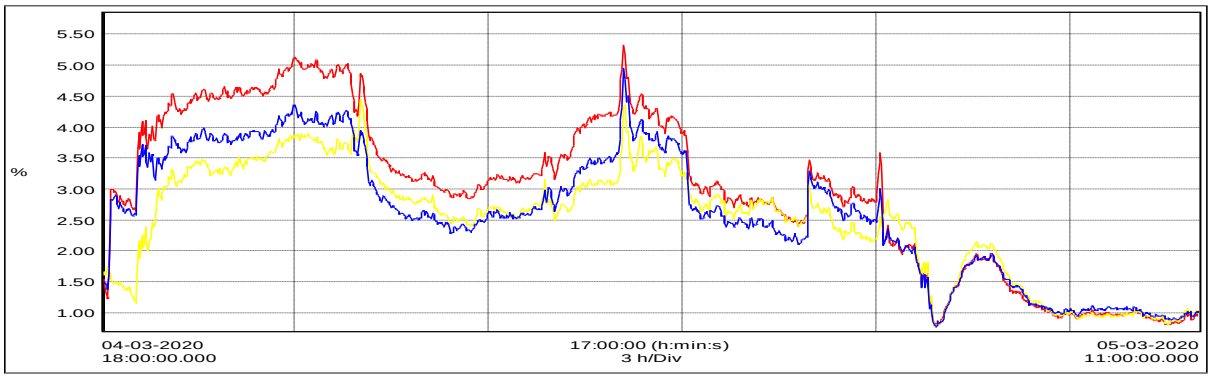
Parameter	Unit	Average	Minimum	Maximum
Active Power R	kW	20.9	7.6	52.8
Active Power Y	kW	18.8	6.8	48.4
Active Power B	kW	20.7	6.5	51.2
Active Power Total	kW	60.4	21.7	152.4

Power - Apparent (kVA):



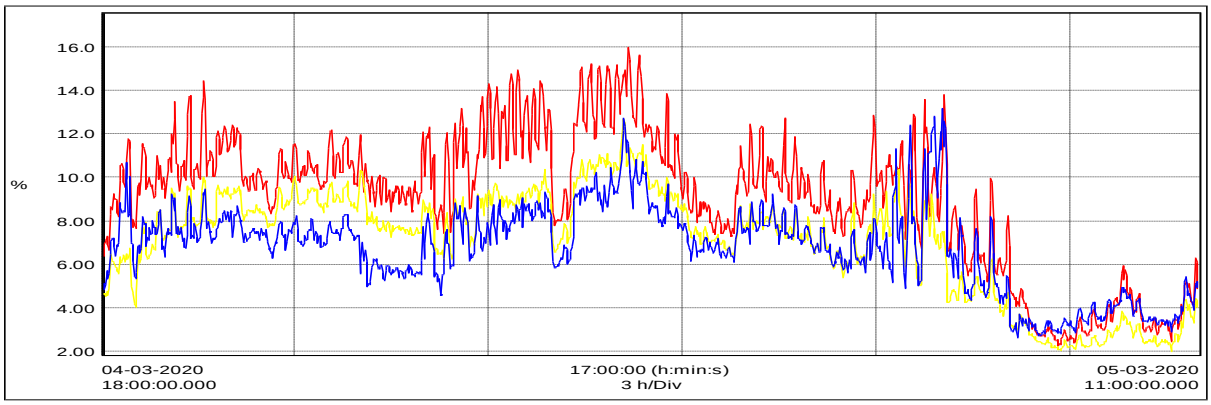
Parameter	Unit	Average	Minimum	Maximum
Apparent Power R	kVA	22.5	7.8	60.0
Apparent Power Y	kVA	21.1	6.9	59.3
Apparent Power B	kVA	22.7	6.6	57.4
Apparent Power Total	kVA	66.2	22.0	176.0

Voltage THD (%):



Parameter	Unit	Average	Minimum	Maximum
Voltage RY	%	3.0	0.8	5.3
Voltage YB	%	2.5	0.8	4.5
Voltage RB	%	2.6	0.8	5.0

Current THD (%):

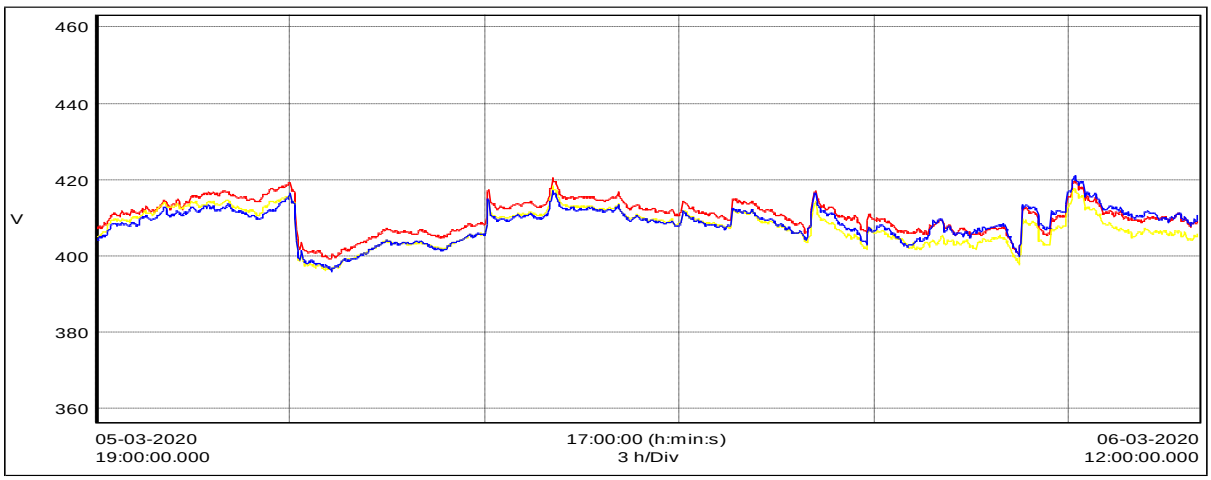


Parameter	Unit	Average	Minimum	Maximum
Current R	%	9.1	2.3	16.0
Current Y	%	7.1	2.0	12.7
Current B	%	6.8	2.7	13.2

Observations:

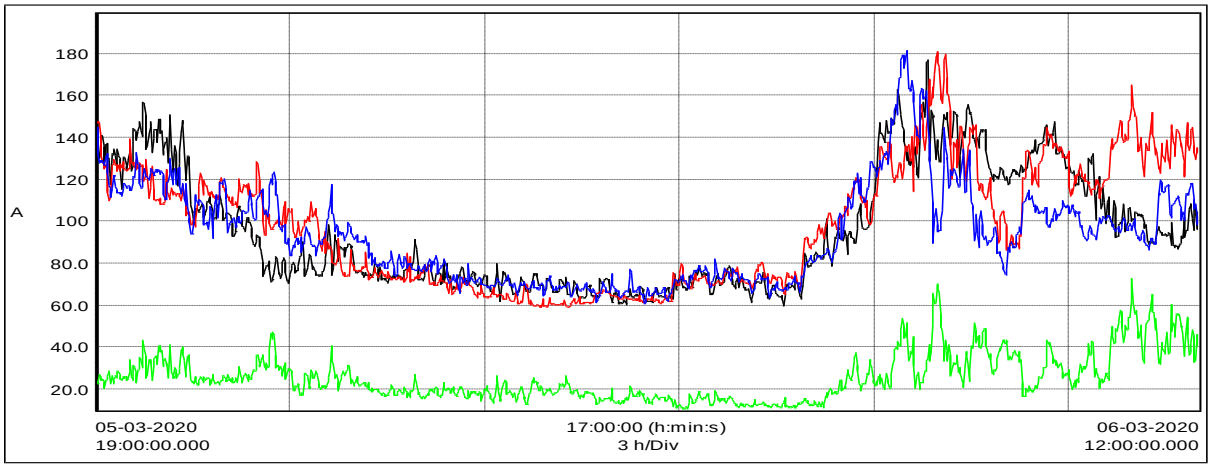
- Voltage Harmonics are within limit of 3%
- Current Harmonics are higher than the stipulated value of 5%

HT 14, Transformer 250 KVA:
Voltage (V):



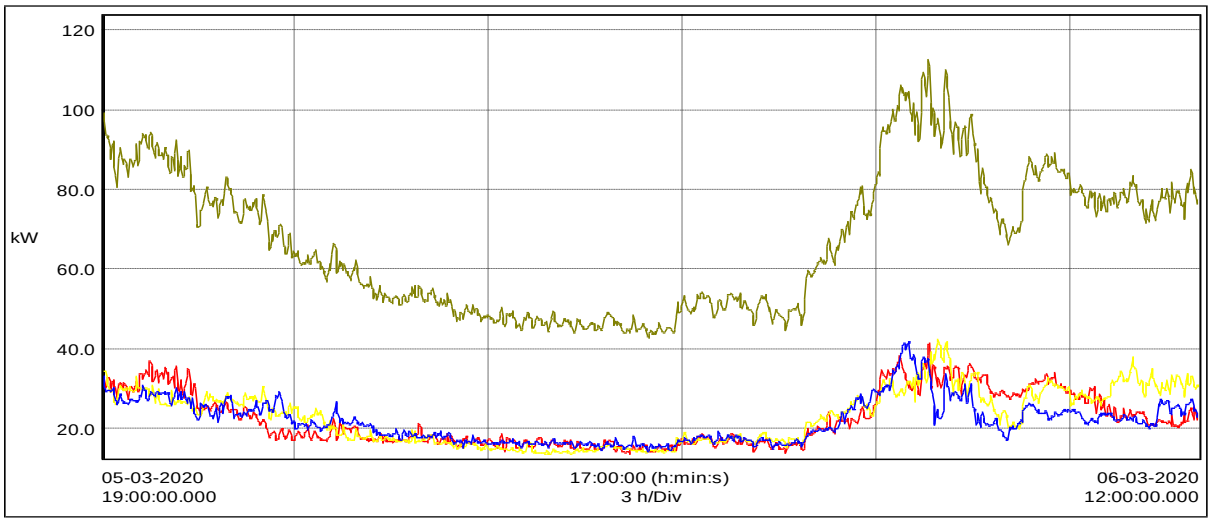
Parameter	Unit	Average	Minimum	Maximum
Voltage RY	V	410.6	398.6	421.2
Voltage YB	V	407.8	395.6	418.9
Voltage RB	V	408.6	392.6	421.8

Current (A):



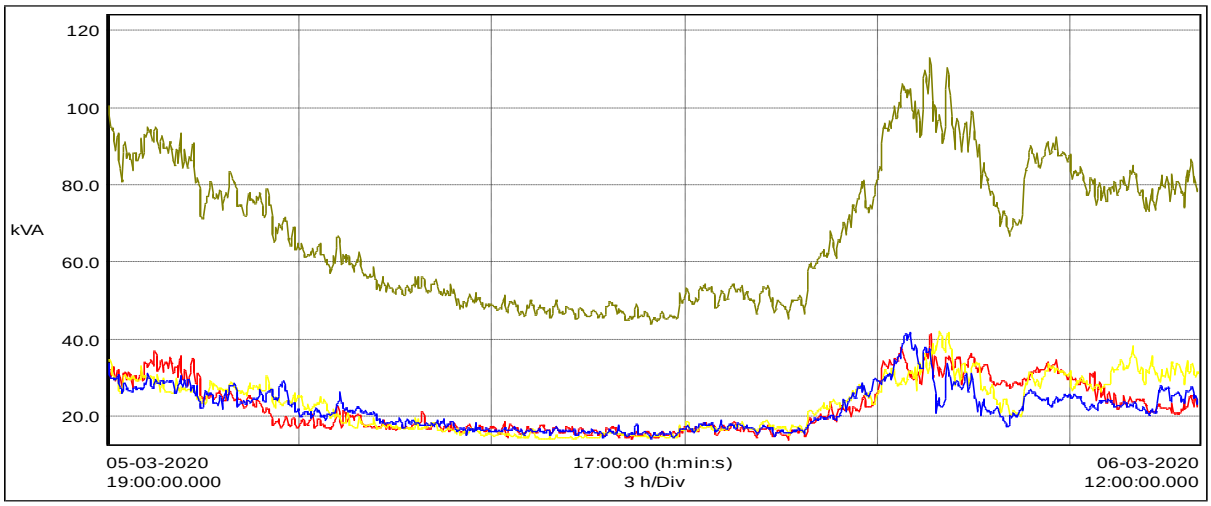
Parameter	Unit	Average	Minimum	Maximum
Current R	A	99.8	58.4	185.4
Current Y	A	102.5	58.9	188.8
Current B	A	96.5	61.0	188.4
Current N	A	28.0	10.4	78.7

Power – Real (kW):



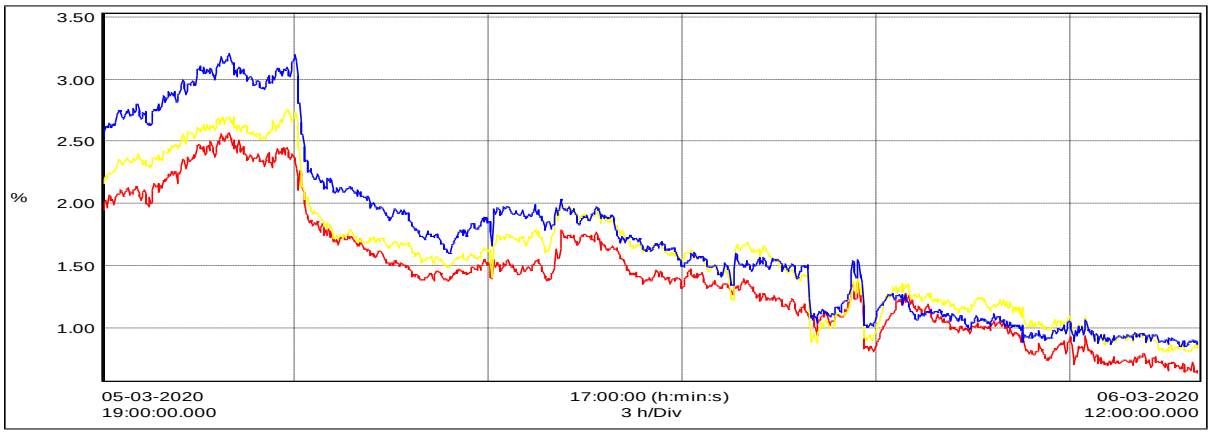
Parameter	Unit	Average	Minimum	Maximum
Active Power R	kW	22.4	13.7	41.4
Active Power Y	kW	22.9	13.6	42.3
Active Power B	kW	21.8	14.3	41.8
Active Power Total	kW	67.1	42.9	112.7

Power - Apparent (kVA):



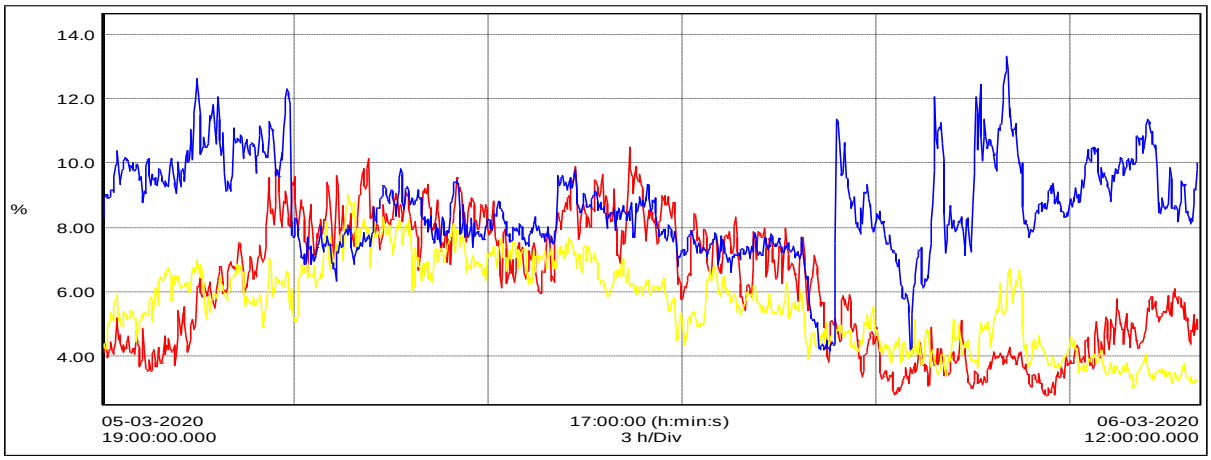
Parameter	Unit	Average	Minimum	Maximum
Apparent Power R	kVA	22.6	14.1	41.4
Apparent Power Y	kVA	23.2	14.2	42.3
Apparent Power B	kVA	22.0	14.4	41.8
Apparent Power Total	kVA	67.9	44.2	112.9

Voltage THD (%):



Parameter	Unit	Average	Minimum	Maximum
Voltage RY	%	1.4	0.6	2.6
Voltage YB	%	1.6	0.8	2.8
Voltage RB	%	1.7	0.9	3.2

Current THD (%):

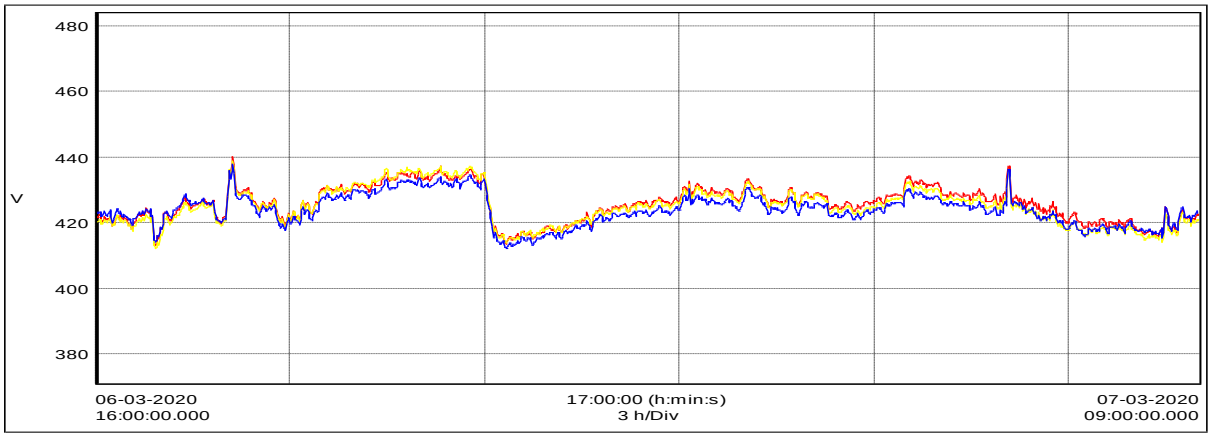


Parameter	Unit	Average	Minimum	Maximum
Current R	%	6.2	2.8	10.5
Current Y	%	5.7	3.0	9.0
Current B	%	8.6	4.2	13.3

Observations:

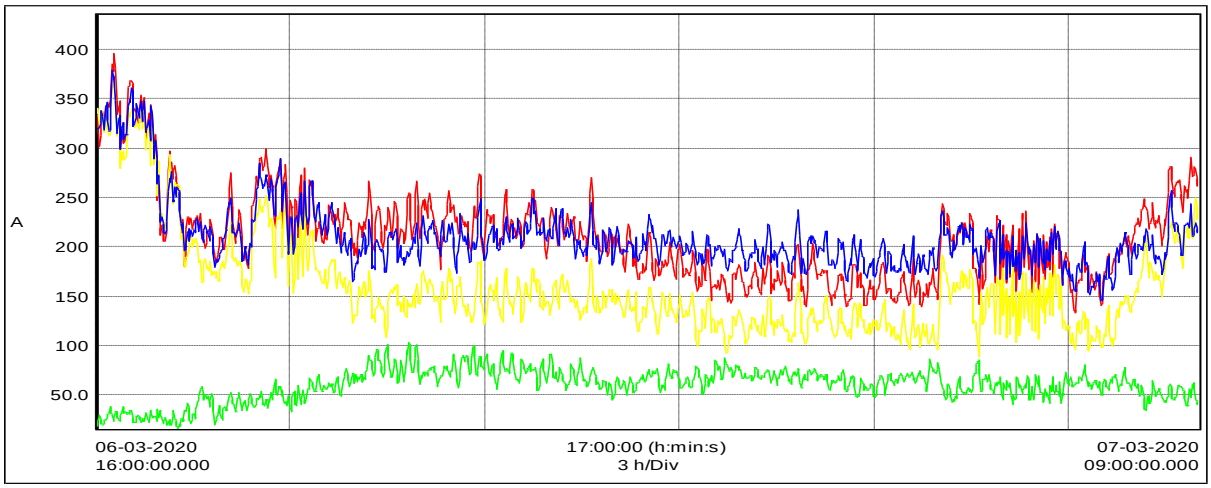
- Voltage Harmonics are within limit of 3%
- Current Harmonics are marginally higher than the stipulated value of 5%

HT 14, Old Transformer 500 KVA:
Voltage (V):



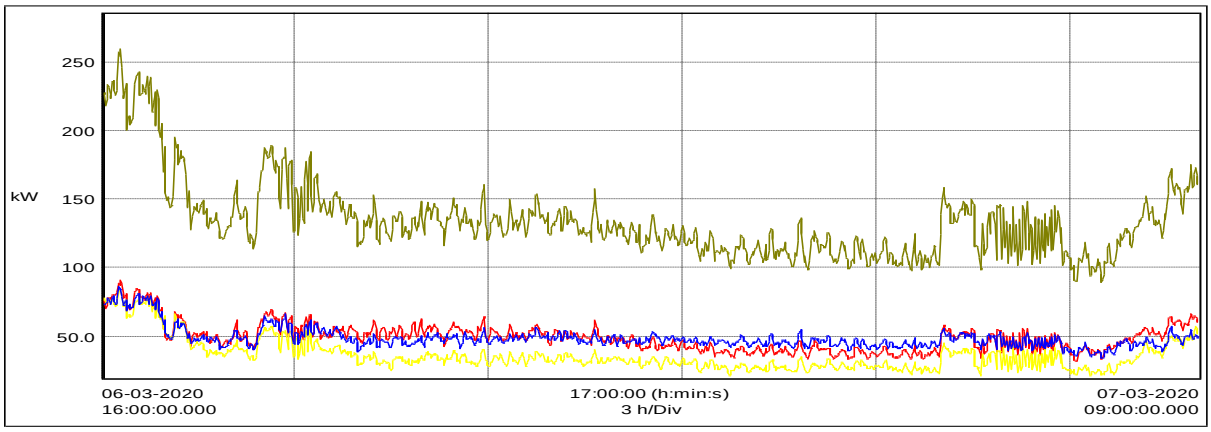
Parameter	Unit	Average	Minimum	Maximum
Voltage RY	V	425.9	409.7	440.6
Voltage YB	V	425.1	410.0	439.7
Voltage RB	V	424.1	407.9	438.7

Current (A):



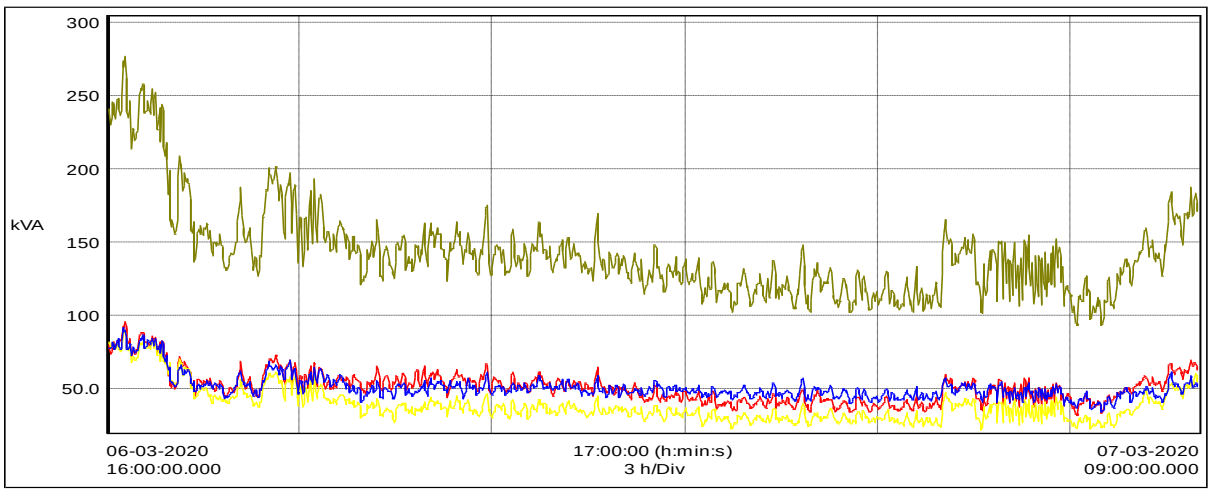
Parameter	Unit	Average	Minimum	Maximum
Current R	A	216.2	130.2	437.2
Current Y	A	169.3	84.4	408.0
Current B	A	214.3	138.5	432.5
Current N	A	62.8	15.9	110.0

Power – Real (kW):



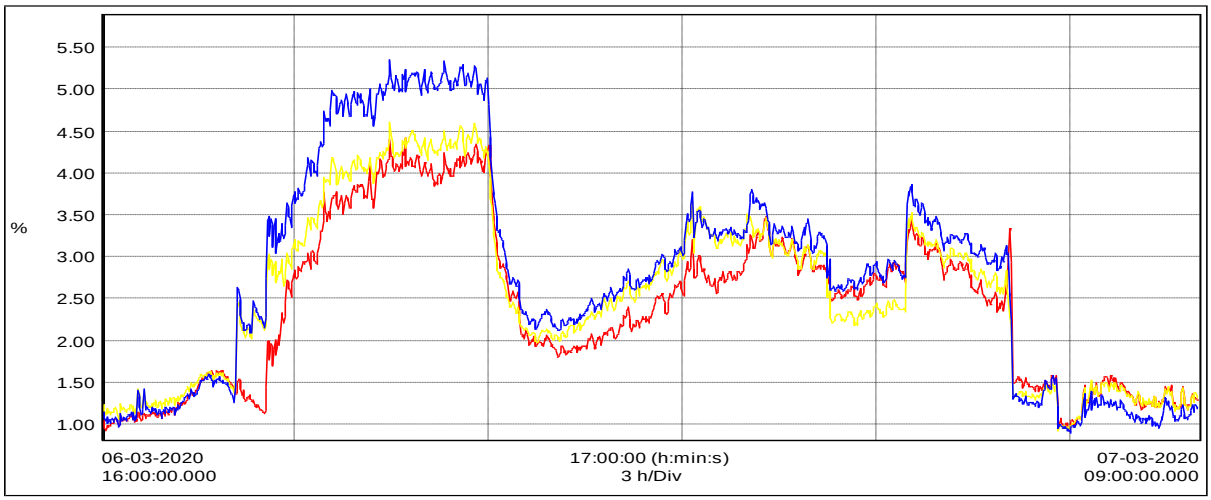
Parameter	Unit	Average	Minimum	Maximum
Active Power R	kW	49.4	31.8	91.0
Active Power Y	kW	36.4	21.1	84.3
Active Power B	kW	48.9	34.2	86.2
Active Power Total	kW	134.8	89.7	260.1

Power - Apparent (kVA):



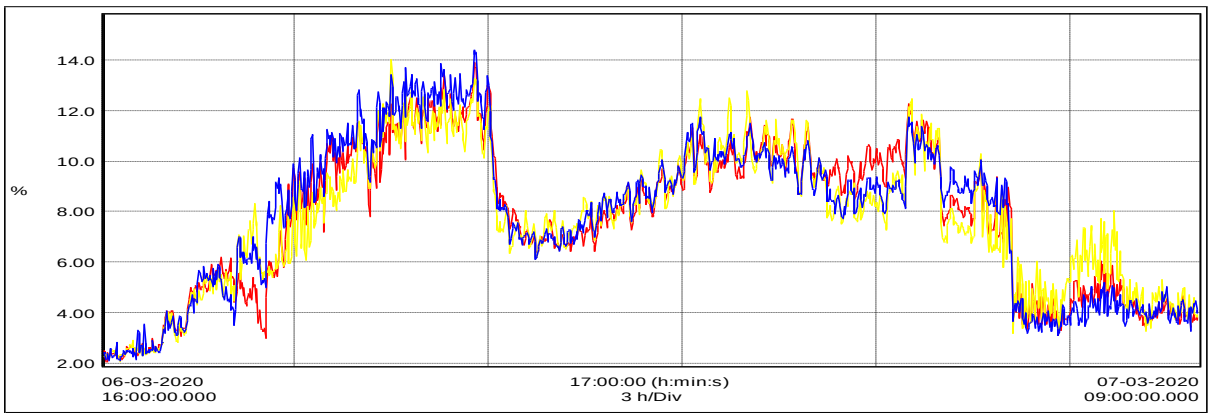
Parameter	Unit	Average	Minimum	Maximum
Apparent Power R	kVA	51.7	32.7	96.0
Apparent Power Y	kVA	39.7	22.4	90.3
Apparent Power B	kVA	51.5	35.2	92.0
Apparent Power Total	kVA	142.9	93.5	277.1

Voltage THD (%):



Parameter	Unit	Average	Minimum	Maximum
Voltage RY	%	2.4	0.9	4.4
Voltage YB	%	2.6	0.9	4.6
Voltage RB	%	2.8	0.9	5.4

Current THD (%):



Parameter	Unit	Average	Minimum	Maximum
Current R	%	7.7	2.1	13.9
Current Y	%	7.7	2.1	14.0
Current B	%	7.9	2.2	14.4

Observations:

- Voltage Harmonics are within limit of 3%
- Current Harmonics are marginally higher than the stipulated value of 5%

However, it is difficult to quantify energy saving through harmonic mitigation. The harmonic mitigation may therefore be undertaken if mandated by the government or impacting performance of electronic system / equipment.

Impact of Harmonics:

Tripping of circuit breakers and fuses:

Due to resonance effects, the current levels may rise to multifold levels, which results in tripping of the breakers and melting fuses.

Impact of Harmonics on Transformers:

The eddy current loss increases with the square of the frequency while hysterics losses increase linearly with the frequency. Thus, losses also increase due to harmonics also leading to additional heating of the transformer.

Impact of Harmonics on Motors:

The eddy current loss increases with the square of the frequency while hysterics losses increase linearly with the frequency. Therefore, higher frequency voltage components produce additional losses in the core of AC motors, which in turn, increase the operating temperature of the core and the windings surrounding the core. Application of non-sinusoidal voltages to motors results in harmonic current circulation in the windings of motors.

Stray motor losses, which include winding eddy current losses, high frequency rotor and stator surface losses, and tooth pulsation losses, also increase due to harmonic voltages and currents

The interaction between the positive and negative sequence magnetic fields and currents produces torsional oscillations of the motor shaft. These oscillations result in shaft vibrations. If the frequency of oscillations coincides with the natural mechanical frequency of the shaft, the vibrations are amplified and severe damage to the motor shaft may occur.

Overloading of the capacitors:

The capacitors are overloaded due to harmonics producing excessive heat. As the capacitive reactance decreases with the frequencies, even smaller amplitudes of the harmonic voltages result into higher currents, which are detrimental to the capacitors.

Losses in distribution equipment:

Harmonics in addition to the fundamental current cause additional losses in the cables, fuses and also the bus bars.

Excessive currents in the neutral conductor:

The phase currents cancel each other in neutral, and resultant neutral current is zero under balanced load conditions without harmonics. However, in a 4-wire system with single- phase non-linear loads, odd numbered multiples of the third harmonics (3^{rd}, 9^{th}, 15^{th}) do not cancel, rather add together in the neutral conductor. The neutral currents may rise and there is a possibility of excessive heating of the neutral conductor.

Malfunctioning of the Electronic Controls and Computers:

Electronic controls and computers relay on power quality for their reliable operation. Harmonics result into distorted waveforms, neutral currents and over voltages, which affect the performance of these gadgets.

Measurement errors in the metering systems:

The accuracy of metering systems is affected by the presence of harmonics. Watt-hour meters accurately register the direction of power flow at harmonic frequencies, but they have amplitude errors, which increase with frequency.

Corrective Actions:

The corrective actions involve installation of

- Passive harmonic filters
- Passive & Active harmonic filters
- Active harmonic filters