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Ref no: RECM/EA/ 3811/1 /21-22 **Date 31.03.2021**

ENERGY, ENVIRONMENT & GREEN AUDIT CERTIFICATE

This is to certify that, Yuvaraja's College (Autonomous) situated at JLB Road, Mysore -570005 (Karnataka) has been audited for energy, environment & green conservation systems & practices adopted till March 2021 and the further 2021-22 auditing is in progress.

Energy, environment & green audit covered the entire campus, consisting of Yuvaraja college buildings, Platinum jubilee building and other facilities, on energy conservation, renewable energy, waste management & greenery maintenance.

Audit report has been prepared based on study, site visit & data collected measurements and verification done during the course of audit. Energy audit is related to connection having RR No HT444(0641504157) , Contract Demand 250KVA

Audit has been conducted by our team of qualified and certified engineers in accordance with standards & guidelines set by, BEE- Bureau of energy efficiency, ECBC – Energy Conservation Building Code, PCB- Pollution control board guidelines, ASHRAE and other standards.

Audit also considered guidelines of NAAC National Accreditation Council under institutional values related to energy, environment & green.

-ANIL KUMAR NADIGER,B.E.(E&E),M.I.E
Director & Energy Specialist
RACHANA ENER CARE
‹Engineers for Energy & Environment›

Consultancy, Projects & Innovations
>Energy Conservation, audits –Govt. Certified Energy Managers & auditors
>Resources (Solar , Wind, Bio gas)
>Power conditioning, quality & safety

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Energy, Environment & Green audit report

Of

UNIVERSITY OF MYSORE

YUVARAJA'S COLLEGE (Autonomous)

(A CONSTITUENT AUTONOMOUS COLLEGE OF THE UNIVERSITY OF MYSORE)

Re-Accredited A Grade by NAAC with CGPA of 3.34 & College with Potential for Excellence

MYSORE - 570 005.

Prepared by:

Feb 2022

(inclusive of 2019-21)

RACHANA ENER CARE

Engineers for Energy& Environment

(Team of BEE-Dept of energy Certified energy managers & auditors)

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I. Work order details

Title	Energy ,Environment & Green audit
Scope	Evaluation of present condition & scope for improvement
WO number & date	UOM/YCM/WO/852/2021-22 Dt 09.11.2021 (Due to Covid 19, work order was given during 2021-22, the report is inclusive of 2019-20, 2020-21 also)
Study & Report submission	Feb 2022
Conducted by	Rachana Ener Care (Engineers for energy & environment) Team of BEE (Govt of India) certified energy managers & auditors –Mysore Environment consultants NIE CREST- Centre for Renewable energy & sustainable technologies - Mysore
Contact person	ANIL KUMAR NADIGER (Director & Energy Specialist)
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II Acknowledgement

We appreciate the initiation taken by YUVARAJA'S COLLEGE (AUTONOMOUS), UNIVERSITY OF MYSURU, JLB Road, Mysuru for their interest to have an energy environment & green audit. This will not only benefit institutions but society at large.

We are thankful to the institution for giving this opportunity to us. This is a great opportunity for us to serve in our passionate area of energy & environment.

We are thankful to the Principal & all staff for this initiation and giving consent to conduct an audit.

We are thankful to the office staff providing us data. Thanks to all office staff & other members who have supported us in the audit process.

Head of NIE CREST (National Institute of Engineering) Mr. Sham sunder has provided vital information and constancy in waste management & green technologies. Thanks to NIE CREST & team

We need to mention our gratitude to the entire workforce of the institution, who have co operated and shared information during our frequent visit to campus.

Sustainability in Energy & Environment is everyone's need & its conservation is everyone's responsibility. But practicing is a challenge. We are sure that institution will go ahead in this regard.

Thank you.

For RACHANA ENER CARE

ANIL KUMAR NADIGER

B.E. (E & E) M.I.E

(DIRECTOR & ENERGY SPECIALIST)

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1. Abbreviations and Glossary

AC – Alternating Current

AH - Ampere Hour (Used to define capacity of battery)

BD – Billing Demand

BEE - Bureau of energy efficiency (A statutory body under Dept of energy India)

BLDC - Brush Less DC fans (Most advance technology fans)

CD- Contract Demand (Power demanded by consumer to ESCOMs)

CFM – Cubic Feet per Minute (measure of flow)

CHESCOM – Chamundeswari electricity Company

CT - Current transformer (small device used in electrical panel)

DC - Direct Current

DG - Diesel Generator

DG – Diesel Generator

DISCOMS - Distribution Company (electricity)

ECBC - Energy conservation building code

EER – Energy Efficiency Ratio

Efficacy – capacity to deliver desired out put

ESCOM – Electricity Company (CHESCOM ,BESCOM,MESCOM,GESCOM,HESCOM)

EV- Electric Vehicle

HP - Horse power (1hp = 0.745 kw)

HT – High Tension (High voltage 11,000 Volts)

KWH – Kilo watt hour generally used as 'Units'

LED – Light Emitting Diode

LPH – Litre per hour (related to flow)

Lumens- Unit to measure total output light

LUX – Illumination level in unit area

Mains- Electricity supply point

MCC- Mysuru City Corporation

MD- Maximum Demand

NGT – National Green Tribunal

PCB - Pollution control board

PCB – Pollution Control Board

PF – Power factor

PPM – Parts per million (Units of measure)

Refrigerant- Chemical used in refrigerator

RO – Reverse Osmosis

RWH - Rain water Harvesting.

SHCG – Solar Heat Gain Coefficient

SMF – Sealed Maintenance Free

Star label – Indication of energy efficiency of any equipment

TDS - Total dissolved salts

UPS – Uninterrupted Power Supply

VA – Volts and amps multiple

W – Watts – Units to measure power

2.REFERENCES, GUIDE BOOKS & STANDARDS

Guidelines and standards set by following professional bodies, societies and government bodies were used in report. We acknowledge them.

BEE – Bureau of energy efficiency

Nodal agency under department of energy, government of India

NPC – National productivity council

Star label standards – beestarlabel.com

ECBC – Energy Conservation Building Code

ISHRAE- Indian Society of Hating Refrigerating & air conditioning Engineers

ASHRAE- American Society of Hating Refrigerating & air conditioning Engineers

PCB – Pollution Control Board

SEEM – Society of Energy Engineers & Managers

UNSDG- United Nation Sustainable Development Goals - https://sdgs.un.org/goals

KREDL-Karnataka State Renewable Energy Development Ltd

SDA - State designated agency under BEE

3.Executive summary

The purpose of energy , environment & green audit is to evaluate present condition and recommend for possible improvement.

Energy audit will focus on energy consumption trend, Types of load, power quality , opportunity to save energy and use of renewable energy. Cost implication , return on investment and environmental benefit also considered, while suggesting any energy conservation measures

Environmental audit will focus on quantum of waste generation , present way of managing waste adopted, possibility to reduce waste and better management option

Green audit will focus on green coverage, type of flora & fauna , etc

Energy Utilisation Pattern

Power details:

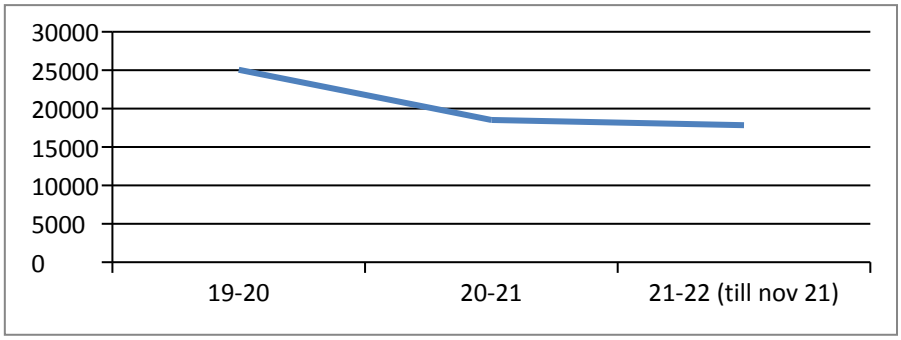
RR No	HT444(0641504157)
Type	INDUSTRIAL- HT2a
Tariff	3HT2A-N
Contract Demand	250KVA
Billing Demand	213KVA
Demand charges	Rs.220/- per KVA +TAX
Energy Charges	Rs 7.20 BASIC + 0.05 FAC + TAX
TAX	6%

Observations:

1) There is common HT supply to Platinum jubilee building, Maharaja College and Yuvaraja college buildings. There is no sub meter to record each building consumption.
2) Energy consumption has been analysed from Apr 2019 to Dec 2021. Due to lock down there is decrease in power demand & energy usage in 2020-21 and may & june months of 2021.
3) Normal working academic year 2019-2020 is considered as base line for energy consumption.
4) Institution complex has consumed 3,00,600 units in 2019-2020. That is 25055 units per month and 822 units per day.
5) Monthly average from 2019 to 2021 has shown decreasing trend.

Year	19-20	20-21	21-22 (till Nov 21)
Monthly average	25055	18519.5	17838.75

Graph: Units consumed v/s monthly average per year

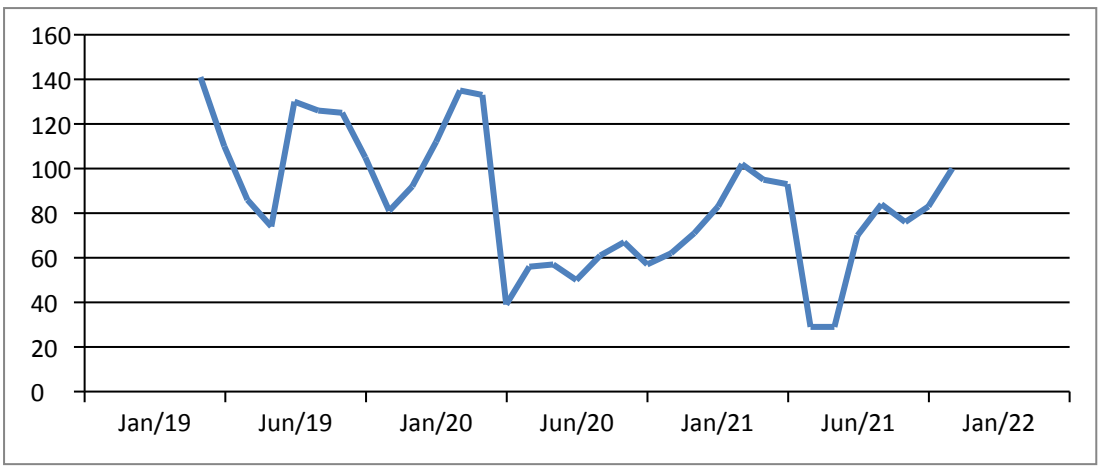


6) To analyse present energy usage trend , we have compared sept-nov 2019 with 20-21 and 21-22 .

Month	19-20	20-21	21-22
Sept	29162	16832	19042
Oct	24805	17682	17255
Nov	22710	18175	21127
total energy (three months)	76677	52689	57424

7) There is decrease trend in energy consumption , even after classes returned to normal.

8) Institution has contract demand of 250 kva and billing demand of 213 kva. After analysing about 36 months bill, we found maximum demand has not crossed 150kva.



9) Institution has maintained overall power factor of 0.99 to unity using powr factor corrector system ,which is appreciable.

10) Connected load in the institution is about 200kw

11) Power demand of institution is 25kva to 35 kva and will not cross 50kva

12) Energy consumption per month is estimated as.7000 to 8000 units

13) There is no solar photovoltaic system. It is recommended to install solar photo voltaic system ,preferably on grid system . On grid system will supply energy for own use and excess energy during holidays can be exported to grid. Recommended solar roof top capacity to make campus as 'net zero energy' or carbon neutral is discussed in preceding chapter.

14) Presently 10kwp solar off grid system for computer lab usage is in process

15) Presently there is no diesel generator. Power cut duration is about 3 to 5%. Institution is depending on UPS system for emergency back up. This has reduced air pollution by generator exhaust.

16) There is very limited use of air conditioners. Its usage i limited to lab purpose, that too not regularly , but as and when required. It is appreciable that there is no use of air conditioner for human comfort purpose and campus is well ventilated.

Energy Conservation Measures Table

sl	Proposal	Investment (rs)	Energy saved per annum (units)	Payback period (years)	Carbon dioxide saved per annum
1	Replacing all Regular 1242 regular Tube lights to LED	4,34,700/-	37260	1.56 years	44712kgs
2	Replacing 17 very old & 376 old fans totally 393 fans to recent technology BLDC fans	9,82,500/-	29475	4.44 years	35370
3	Switch off inverter section of Online UPS, when not in use	nil	7008	-na-	8410
4	Use of SMPS charger for on line UPS	60,000/-	3504	2.2 years	31526
5	Solar off grid system in lieu of regular UPS (additional cost for 5kva)	2,00,000/-	4500	4.9 years	5400

Note:

- Above is indicative only. Actual investment and payback period may vary time to time.
- Professional advice is required before any change in the system or implementing new system

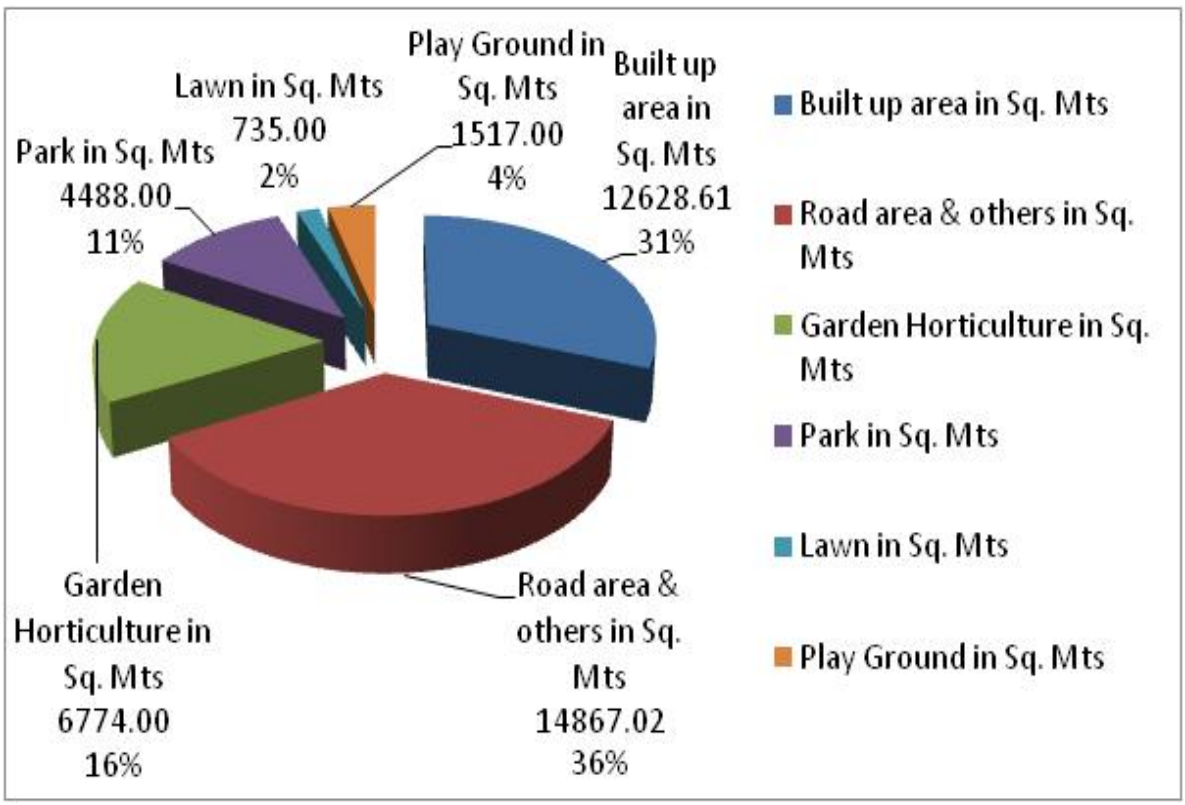
Environmental audit observations

1) Institution is sourcing it water needs mainly from corporation. An average 286000 ltrs per month of water is consumed from corporation. This is mainly used for basic needs of more than 4000 students and staff. Water required for garden purpose is sourced from Kukkarahalli lake. Institution also has bore well for its emergency need.
2) Water conservation measures: Institution new building has well designed RWH Rain water harvesting system of 1.5 lakh litre capacity. RO purifier system is used for lawn purpose. We recommend regular maintenance of RWH for proper utilisation.
3) Other conservation measures such as bore well recharge, flow control valves for taps, automatic controls can be adopted for further water conservation.
4) Water used for human basic needs is drained to corporation UGD system. Entire college campus can have a common Sewage treatment plant (STP) as long term water conservation measure.
5) Dry waste : Waste papers , dry leaves , small amount of plastic wastes are generated in the campus. All individual departments have dust bins. Dust bins are also placed in common places and park area. These are collectively dumped in a common place. This will be picked up by corporation. We recommend to keep a large collector bins , instead of dumping in open place. It is also recommended for more awareness boards , particularly in park & common areas. We also recommend to install composter to convert dry leaves to manure. This is useful for your garden purpose.
6) Wet waste: Quantum of wet waste generation is very less. Canteen is disposing it as cattle feed. Majority of students carry back their left over food back to home. However it is good practice to have wet waste collector bins.
7) Hazardous waste : Used tubes which contain mercury , computer parts which is main e waste , Batteries having lead waste constitute major hazardous waste. Old batteries are disposed by way of 'Buy back' system. This is approved way of disposal by pollution control board. Used tube lights are given to corporation. All other E waste is given to scrap dealer. As per E waste management act such tubes has to be disposed after properly packing and labelling. Guide lines copy is given in annexure.
8) Other hazardous waste: Institution has more girls students. Hence considerable amount of sanitary pad waste will be generated. Institution has incinerator in all rest rooms. Other hazardous waste is the chemical waste from labs. Quantum generation is less. These are buried in barren land

9) Noise & air pollution: Due to restricted movement of vehicles and parking places sound and noise pollution is less. In addition ,there is no generator system. Students are advised not to unnecessarily use vehicle horns in the campus. We have advised to provide E vehicle charging facility to two wheelers as initiative to encourage E vehicles.

Green audit observations

1) Institution has best utilised the space available to keep campus green , There are large trees, plants, ornamental plants in park and also in corridor of new building.
2) Trees and plants are labelled with both common and scientific name. This initiates will enhance interest among students and also in visitors
3) About 30 % of area is covered by green with large trees, small plants , ornamental plants and lawn.
4) More than 150 different types of vegetation are available the campus
5) More than 50 different resident & migratory birds can be seen in the campus.
6) There is neither natural or artificial water bodies in the campus.



Awareness activities

- Institution has conducted about 20 program to create awareness among students . This programs were done both inside and outside the campus, both independently and along with other organisations. About 1500 students and staff were participated in these programs.
- Institution has also fixed boards to create awareness on plastic free zon and protecting nature. We feel that there is need to add more posters and boards in th campus.

Consolidation

Best practices & systems adopted;

1) Maximum demand has not crossed contract demand any time (CD 250kva ,MD less than 150kva)
2) Power factor correction is good ranging from 0.99 to unity.
3) Air conditioner usage is limited
4) New auditorium and other installations have adopted LED lighting
5) Campus is largely depending on UPS and not any DG source at present
6) New building has good natural illumination (day light)
7) Water requirement is mainly sourced from corporation , which has less hardness and hence no salt deposition on any taps
8) New building has well designed RWH unit
9) RO drain water is used for lawn
10) Water is sourced from Kukkrhalli lake for gardening purpose
11) Campus is maintained green & clean in most of places
12) Garden has more than 150 verity of plants & more than 50 types of birds
13) Plant are labelled to educate and develop interest.
14) Awareness boards are kept at many strategic locations
15) Inside and outside campus activities are regularly carried out

Limitations:

1) Limited use of LED lights
2) old fans are still in use
3) Illumination level is less in many class rooms in old buildings (lights not working)
4) Renewable energy usage is less (present 6 solar lights are also not working)
5) Electrical panel boards have rats inside to be protected immediately
6) Panel boards needs metering, labelling and SLD (Single Line Diagram)
7) Dust bins and central collection bins are needed
8) Old tubes & e waste to be disposed as per PCB norms
9) More awareness boards required
10) Automatic controls are implemented (see list below)
11) RWH (Rain Water Harvesting) system not maintained

Prioritizing implementation

1)solar street lights 2 nos @ cost Rs. 20,000/-
2)composter (small) @ cost Rs. 6000/-
3)composter (large) @ cost Rs. 25000/-
4)repair of RWH (rain water harvesting) @ cost Rs. 30000/-
5)Recharge pit for bore well @ cost Rs. 5000/-
6)awareness boards @ cost Rs. 2000/-
7) Awareness program (about audit) @ cost Rs. 1000/-
8)Energy meter CT and wiring 2nos@ cost Rs. 10,000/-
9) Labelling & primary protection for electrical panels@ cost Rs. 5000/-
9) Waste collection bins – (Corporation)
10)LED tubes at main places 25nos X300/-each @ cost Rs. 7500/-
11)BLDC fans in place of old fans – 10nos x 3000/-each @ cost Rs.30,000/-
12)solar off grid system @ cost Rs. 5,00,000/-
13) Automation - timer/ occupancy sensor/ day night switch. 1500/- x 2nos each @ cost Rs. 3000/-
14)Flow control for taps (Pressure reducer valves) 10 nosX 150/- each@ cost Rs1500/-
15)EV charging points for two wheelers @ cost Rs. 5000/-
16) Big collector for dry waste @ cost Rs. 5000/-

Other recommendations with long term benefits

1)Converting all regular lights to LED lights

2) Replacing all fans to energy efficient fans

3)Solar 'on grid' system for entire campus

4)STP –Sewage Treatment Plant for entire campus

5)Composters of higher capacity

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4.Introduction

4.1 Introduction : Yuvraja college, Rachana Ener Care & NIE CREST

YUVARAJA'S COLLEGE (AUTONOMOUS), Under UNIVERSITY OF MYSURU:

Yuvaraja's College, one of the four constituent Colleges of the University of Mysore is rich in history. It was first established as an Intermediate College on 24th June 1928 and in the year 1947-48, after Independence, the college was upgraded to a First Grade College. The University Grants Commission conferred Autonomous Status to the college in the year 2005 and it was extended up to 2020 in the year 2012. Currently, it offers various academic programs leading to B.Sc., BCA, BBA, Integrated M.Sc., M.Sc., M.A., M.B.A., and Ph.D. degrees for both boys and girls. Quality enhancement and sustenance being the hallmark of this institution is further proved during the third cycle of re-accreditation by NAAC in December 2015 at 'A' Grade with an upgraded CGPA of 3.34. Recently the college has been granted by UGC the status of College with potential for excellence for the second phase from year 2017-2022.

RACHANA ENER CARE:

Rachana ener care headed by Mr.Anil kumar Nadiger, is a team of experienced and qualified engineers, BEE certified energy manager and auditors. Its team members have undergone many training and certification programs. Such as ECBC, ASHRAE standards, Green buildings ,etc conducted by NPC- National Productivity Council, KREDL – Karnataka Renewable Energy development ltd, ISHRAE – Indian Society for Heating Refrigeration &Air conditioning engineers, SEEM – Society for energy engineers & managers, etc It has conducted many audits to reputed clients like South Western Railways, Karnataka Urban water supply & drainage board, Central workshop, Police training centre, Teresian college, NIE, Institution of engineers India & many more. They also conduct training & workshops for professionals , students & entrepreneurs

NIE CREST:

NIE-Center for Renewable Energy and Sustainable Technologies (NIE-CREST) is a renowned Green technology promoting centre at the premises of The National Institute of Engineering (NIE), Mysore. The centre promotes eco- friendly energy systems, Renewable Energy and sustainable technologies. The Centre itself has successfully implemented numerous projects on eco-friendly and - renewable energy systems and sustainable technologies at International & National Level. NIE -CREST provides technology for, Design & Implementation of Renewable Energy Systems, Design and project, execution of Solar, Biomass & Other RE Devices, Design & Implementation of sustainable Technologies, Design & implementation of Technologies for Green Building, Design and implementation Of Rainwater Harvesting Systems and many more.

4.2 Energy, Environment and Green: Need for conservation & Audit

The rapid urbanization and economic development at local, regional and global levels has led to several environmental and ecological crises. On this background, it becomes imperative to develop & adopt new technologies, system and best practices that could lead to sustainability. Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, we also need social and economic resources. Sustainability is not just environmentalism. Embedded in most definitions of sustainability we also find concerns for social equity and economic development.

The Sustainable Development Goals (SDGs) or Global Goals are a collection of 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all". The SDGs were set up in 2015 by the United Nations General Assembly (UN-GA) and are intended to be achieved by the year 2030. They are included in a UN-GA Resolution called the 2030 Agenda or what is colloquially known as Agenda 2030. The SDGs were developed in the Post-2015 Development Agenda as the future global development framework to succeed the Millennium Development Goals which ended in 2015.

The 17 SDGs are: (1) No Poverty, (2) Zero Hunger, (3) Good Health and Well-being, (4) Quality Education, (5) Gender Equality, (6) Clean Water and Sanitation, (7) Affordable and Clean Energy, (8) Decent Work and Economic Growth, (9) Industry, Innovation and Infrastructure, (10) Reduced Inequality, (11) Sustainable Cities and Communities, (12) Responsible Consumption and Production, (13) Climate Action, (14) Life Below Water, (15) Life On Land, (16) Peace, Justice, and Strong Institutions, (17) Partnerships for the Goals.

There is need to involve all strata and demography of society to achieve the goals. Accordingly many organizations from global level to local level are striving hard. In India both government & non government organizations are active. BEE, MNRE, KREDL, ISHRAE, SEEM, TERI, IGBC, ASSOCHAM are some of them.

In order to have green campus, energy conservation, renewable energy usage, waste management, greenery maintenance has become main criteria to evaluate. Audit process includes understanding present condition and recommend suitable best possible improvement. Such suggestion will be based on present technology, guidelines by competent authority, limitations in the site and facilities. Suggestions will be out com of data evaluation, creativity, knowledge & experience, which will benefitall

4.3 Scope of Energy, Environment and Green Audit

Energy Audit:

- Annual energy consumption analysis
- Identify Major connected load & Usage
- Energy Base Line recording .Daily consumption analysis(Voltage, Current, PF, kw, Kwh on each phase - Every min recording for 72 hours, using data logger
- Efficiency rating & effective utilization of major Energy consuming units-Air conditioners, Pumps ,heaters, etc
- Identify energy conservation measures adopted at present –Example LED usage, Star rated fans, fridges, Best practices, etc& possibilities to improve.
- Identify & record renewable energy usage
- Walk through to identify Major Encon measures
- Automation , control and measurement meters ,presently adopted and possibilities to adopt.
- Lux level where lights are used in day time & in main places during night time.
- Option & feasibility study for solar roof top capacity based on site, contract demand & energy consumption.
- Report submission with Return on investment (simple payback period)

Environment audit:

- Water usage & sources
- LUX level day & night at strategic locations
- E waste generated and management and action taken
- Amount of lead generated (UPS & Vehicle batteries)in kgs & action taken
- Solid waste (dry waste) generation and action taken
- Wet waste generation & action taken
- Hazardous waste generation & action taken
- Plastic free environment measures.
- Rain water harvesting
- Waste water management
- Incinerator for sanitary pads

Green audit:

- Greenery maintenance
- Green coverage in campus
- Water bodies**.**

Expected outcome of energy & environment audit & its implementation:

- ✓ Human Comfort & wellness
- ✓ Energy savings : cost savings
- ✓ Extended equipment life ,reduction in breakdown
- ✓ Extended battery life ; cost savings , lead waste reduction, acid fumes reduction.
- ✓ E waste management; Effective Reuse, Recycle concept.
- ✓ Fuel savings.
- ✓ Awareness to students
- ✓ Awareness to public visiting campus.
- ✓ Water savings
- ✓ Eco system maintenance.

5. ENERGY AUDIT

5.1 Introduction to energy Audit:

As mentioned in the earlier chapter, Energy Audit plays an important role in reducing energy bills. In this we have given detailed analysis of bills and setup is done to understand the flow of energy. We can reduce energy bills up to 30% by adopting low cost investment projects also with less than 2 years payback period. We have collected electricity bills and analyzed to identify energy conservation measures. As there are 3 buildings in the campus such as Yuvaraja College, Maharaja College and VC Guest House the total power consuming is 300660KW per year and less than contract demand. In this case there is a possibility to save the energy as well as the cost minimization. Also we will check the possibilities to use renewable energy sources.

The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. The term energy management means many things to many people. One definition of energy management is

"The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions" (Cape Hart, Turner and Kennedy, Guide to Energy Management Fairmont press inc. 1997)

Another comprehensive definition is "The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems"

- To minimise energy costs / waste without affecting production & quality
- To minimise environmental effects.

Energy Audit is the key to a systematic approach for decision-making in the area of energy management.

It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions. Industrial energy audit is an effective tool in defining and pursuing comprehensive energy management

programme. As per the Energy Conservation Act, 2001, Energy Audit is "the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".

Need for Energy Audit

In any industry or organisation, the three top operating expenses are often found to be energy (both electrical and thermal), labour (salary) and materials. If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge

as a top ranker, and thus energy management function constitutes a strategic area for cost reduction. Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists.

The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc. In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a " bench-mark" (Reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization. (Information from BEE- Bureau of Energy efficiency Govt of India)

Promoting energy conservation practices in education sector will help to create awareness in students, which in turn will reach society. Students can incorporate such practices in the profession they involve in future or even take up this as career option. Along with energy conservation , use of renewable energy will provide ultimate suitability.

Your college campus has contract demand of 250kva and recorded maximum demand of 150kva. There is need of about three lakh units of energy requirement. This requirement is expected to grow more by another 25%, because of more facilities, e learning environment ,etc. Presently there is no use of renewable energy except six street lights. In this scenario, there is much scope to improve present condition.

Energy audit will analyses present condition and will recommend ways to improve it. This will be done in following ways.

1)study energy source, consumption pattern and power parameters in last three years

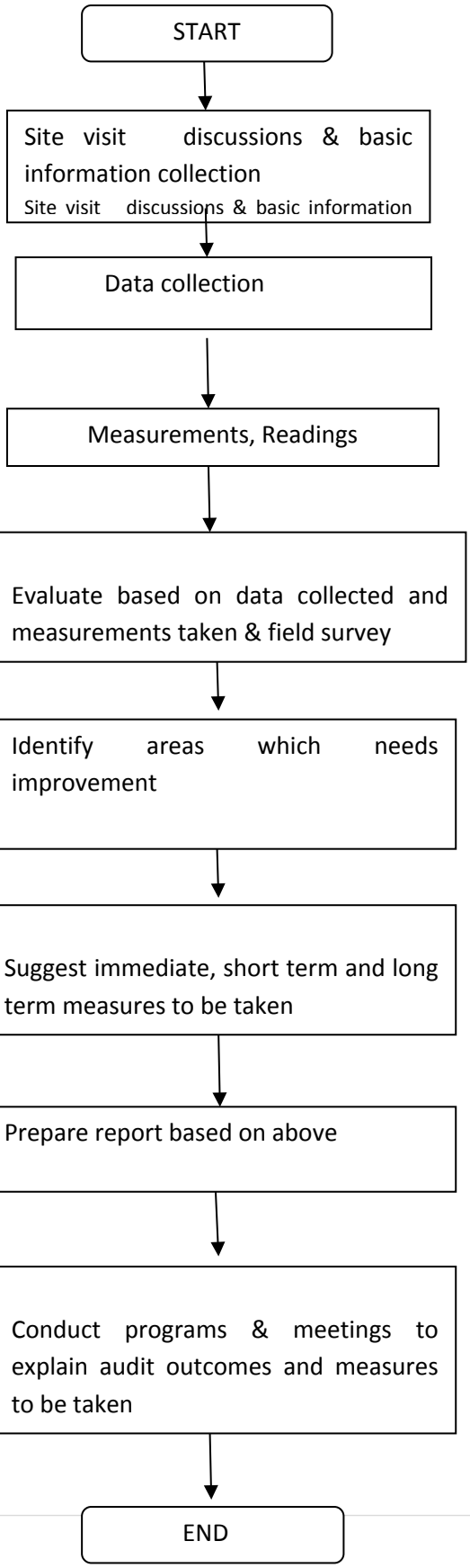
2)Study power quality and energy usage pattern in a day (Power quality)

3)Study connected load type, efficiency (DSM –Demand side management) & suggest changes

4)Study other factors that influence energy consumption. Such as water TDS, Lux level, automation

5)Possibility to incorporate renewable energy

5.2 Flow chart



6. Source side data collection & analysis

6.1 Sources of Energy

Different sources of energy used and in progress in the entire campus are as follows:

Sources	Energy	Remarks
CHESCOM(EB)	150 KVA Contract Demand for total campus	Power demand:25-50 KVA Yuvaraja College Energy demand 80,000 units to 90,000 units annually
LPG	8 to 10 Cylinders per month	For lab use
Solar Energy	20Wx6Nos= 120W	1) Street lights(Presently not working) 2) 10KWP Solar Off grid system is in progress
Diesel Generator	No Generator at present	63KVA Generator installation is in process
Power back up system	93.45 kva	UPS with 2-4 hours back up for computers and labs
Wheeling energy	Nil	Nil

Observation & recommendation:

- Energy consumption is within limit . But, there is need to integrate renewable energy share in utilization.
- ECBC- Energy Conservation Building Code compliance include use of renewable energy and mandates to reserve minimum 25% of roof top space for solar power.
- Energy produced by solar SPVRT* is much economic than all others. Solar energy costs 4 to 5 Rs per unit, Energy by generator costs Rs 25 to 30 rs per unit and present CHESCOM cost of energy is 7.50rs per unit.

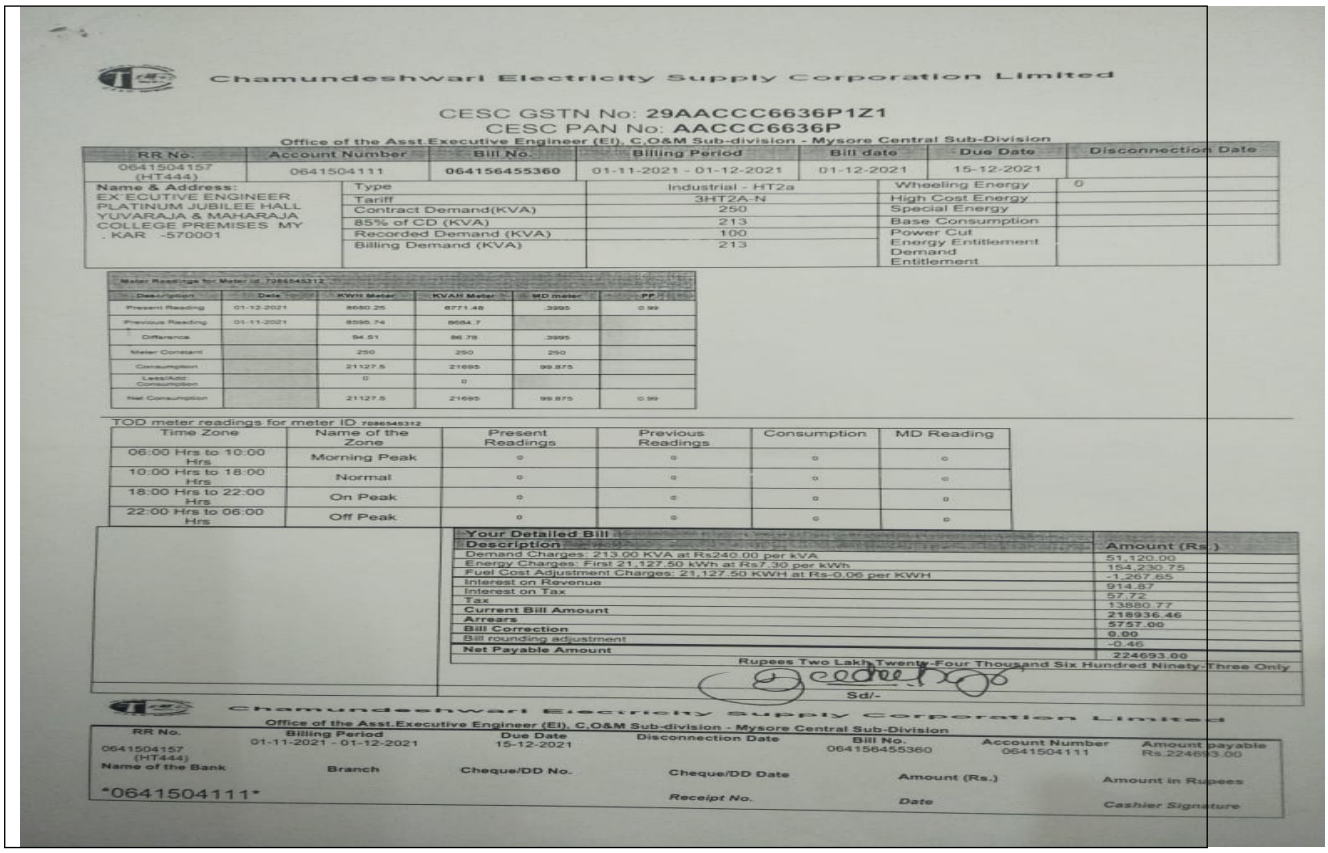
(*SPVRT- Solar Photo Voltaic Roof Top system with net metering facility) .

6.2 Power connection details

Power sanction details:

SOURCE: CHESCOM		
CONSUMER	YUVARAJA COLLEGE	
RRNO	HT444(0641504157)	INDUSTRIAL HT 2A (INSTITUTION)
TARIFF	3HT2AN	
CONTRACT DEMAND (CD)	250 KVA	RS240/- per kva
BILLING DEMAND (BD)	213 KVA	85% OF CD
SUPPLY VOLTAGE	11KV RYB	HT
TRANSFORMER	250KVA	11kv Delta /433v star
Demand charges	240/-Per KVA	Rs51120/- per month+TAX
Energy charges	Rs 7.30 Per KWH	+/- Fuel cost adjustment + taxes

Sample Electricity Bill:



Chamundeshwari Electricity Supply Corporation Limited

CESC GSTN No: 29AACCC6636P1Z1
CESC PAN No: AACCC6636P
Office of the Asst.Executive Engineer (EI), C,O&M Sub-division - Mysore Central Sub-Division

RR No.	Account Number	Bill No.	Billing Period	Bill date	Due Date	Disconnection Date
0641504157 (HT444)	0641504111	0641564455360	01-11-2021 - 01-12-2021	01-12-2021	15-12-2021	

Name & Address:
EX'ECUTIVE ENGINEER
PLATINUM JUBILEE HALL
YUVARAJA & MAHARAJA
COLLEGE PREMISES MY
. KAR -570001

Type	Industrial - HT2a	Wheeling Energy	0
Tariff	3HT2A-N	High Cost Energy	
Contract Demand(KVA)	250	Special Energy	
85% of CD (KVA)	213	Base Consumption	
Recorded Demand (KVA)	100	Power Cut	
Billing Demand (KVA)	213	Energy Entitlement	
		Demand Entitlement	

Description	Date	KWH Meter	KVAH Meter	MD meter	PF
Present Reading	01-12-2021	8680.25	8771.48	.3995	0.99
Previous Reading	01-11-2021	8585.74	8664.7		
Difference		94.51	86.78	.3995	
Meter Constant		250	250	250	
Consumption		21127.5	21695	99.875	
Less/Add Consumption		0	0		
Net Consumption		21127.5	21695	99.875	0.99

TOD meter readings for meter ID 7286549312

Time Zone	Name of the Zone	Present Readings	Previous Readings	Consumption	MD Reading
06:00 Hrs to 10:00 Hrs	Morning Peak	0	0	0	0
10:00 Hrs to 18:00 Hrs	Normal	0	0	0	0
18:00 Hrs to 22:00 Hrs	On Peak	0	0	0	0
22:00 Hrs to 06:00 Hrs	Off Peak	0	0	0	0

Your Detailed Bill

Description	Amount (Rs.)
Demand Charges: 213.00 KVA at Rs240.00 per kVA	51,120.00
Energy Charges: First 21,127.50 kWh at Rs7.30 per kWh	154,230.75
Fuel Cost Adjustment Charges: 21,127.50 KWH at Rs-0.06 per KWH	-1,267.65
Interest on Revenue	914.87
Interest on Tax	57.72
Tax	13880.77
Current Bill Amount	218936.46
Arrears	5757.00
Bill Correction	0.00
Bill rounding adjustment	-0.46
Net Payable Amount	224693.00

Rupees Two Lakh Twenty-Four Thousand Six Hundred Ninety-Three Only

Sd/-

Chamundeshwari Electricity Supply Corporation Limited
Office of the Asst.Executive Engineer (EI), C,O&M Sub-division - Mysore Central Sub-Division

RR No.	Billing Period	Due Date	Disconnection Date	Bill No.	Account Number	Amount payable
0641504157 (HT444)	01-11-2021 - 01-12-2021	15-12-2021		0641564455360	0641504111	Rs.224693.00

Name of the Bank | Branch | Cheque/DD No. | Cheque/DD Date | Amount (Rs.) | Amount in Rupees

0641504111

Receipt No. | Date | Cashier Signature

6.3 Transformer Details

This campus has a dedicated transformer for all three buildings such as Yuvaraja college, Maharaja college and VC Guest house. Following are the details of Transformer:

Capacity	250 KVA
Contract Demand	250 KVA
Peak Demand	150 KVA
Average Load	60
Percentage	24%
Made by	Kirloskar Electric Co. Ltd.
Made in Year	2008
Winding Material	Copper
Star Label	Nil
Primary Voltage	11000
Primary Current	13.1
Secondary Voltage	433
Secondary Current	333.3
Connection	Delta – Star

Remarks:

1) Transformer is not overloaded at any time.
2) Transformer is maintained fairly well.
3) Recommended to spread gravel stones around the transformer to avoid the growth of weeds.

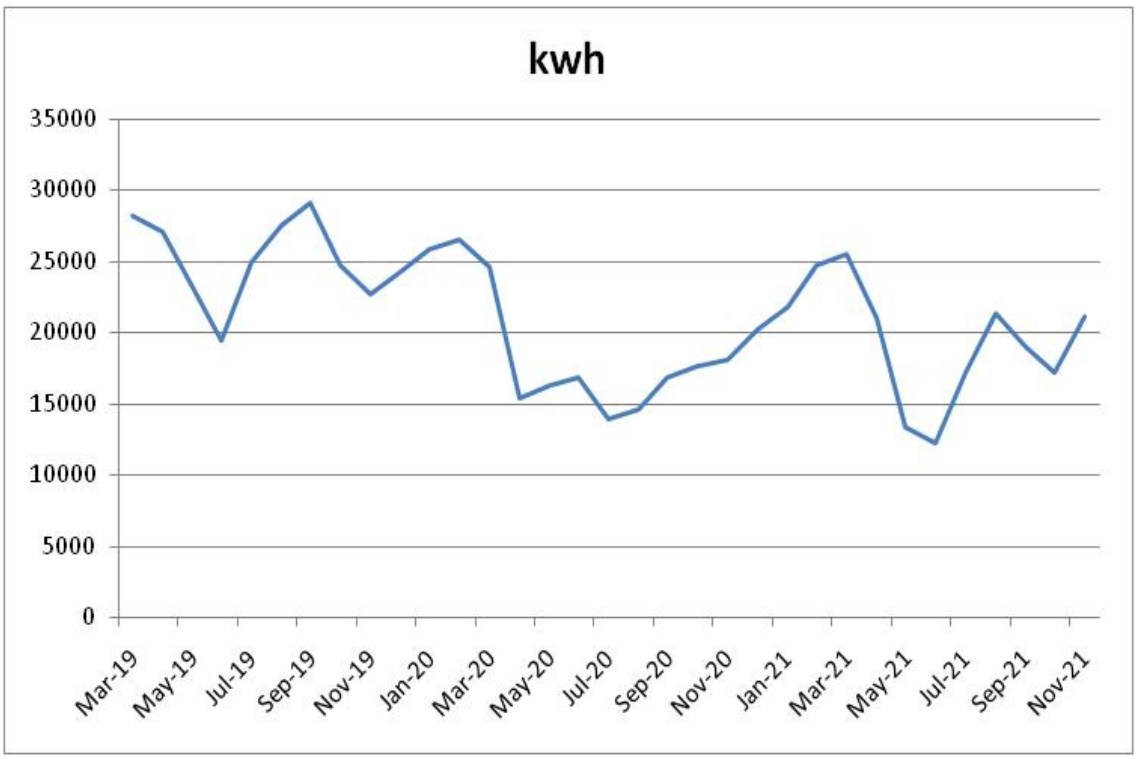
6.4 Energy consumption pattern of three years

Following table gives energy consumption details of last three years.

Month	19-20 KWH	20-21 KWH	21-22 KWH
apr	27137	15372	21010
may	23430	16312	13372
june	19467	16875	12262
july	24965	13975	17247
aug	27555	14595	21395
sept	29162	16832	19042
oct	24805	17682	17255
nov	22710	18175	21127
dec	24270	20287	
jan	25947	21835	
feb	26592	24742	
mar	24620	25552	
Avg/month	25055	18519.5	17838.75
Avg/day	821.4754	608.8603	584.877
Total	300660	222234	142710

(Apr , may 2020 and May ,June of 2021 had corona lock down impact)

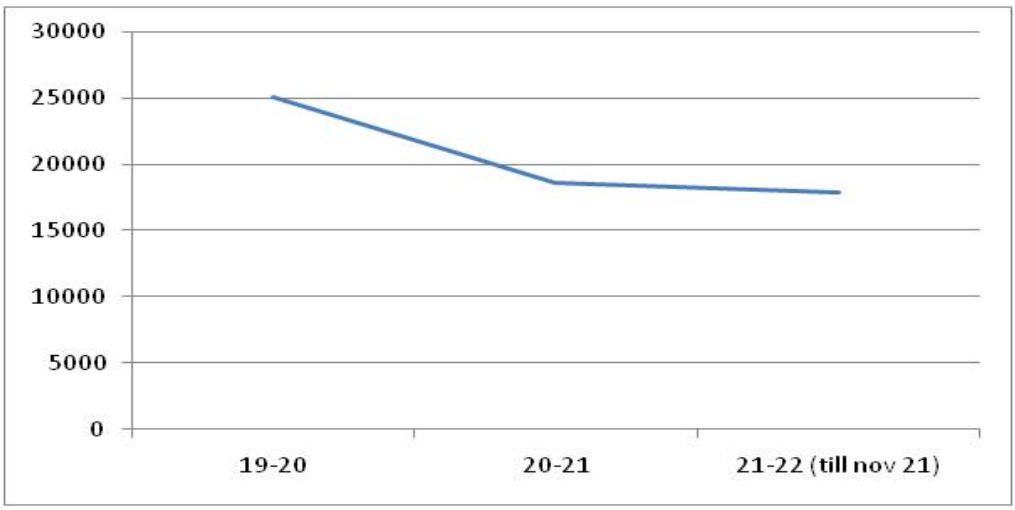
Monthly Energy consumption pattern since last three years



Maximum, minimum & average Monthly energy consumption of campus from April 2019 to November 2021 is given below.

max	29162
min	12262
average	21027.39

Average monthly energy consumption trend 19-20 to 21-22



To analyse present energy usage trend, we have compared sept-nov 2019 with 20-21 and 21-22 there is decrease trend in energy consumption, even after classes returned to normal.

Month	19-20	20-21	21-22
Sept	29162	16832	19042
Oct	24805	17682	17255
Nov	22710	18175	21127
total energy (three months)	76677	52689	57424

Observation & remark:

- Above data gives energy consumption of entire campus, which includes Maharaja college, VC quarters, auditorium etc.
- There is no sub meters to evaluate performance of each separately.
- Covid lock down has impacted academic system both during Year 2020 and 2021.
- In general we find there is increasing trend in energy consumption. There is marginally decrease in consumption pattern

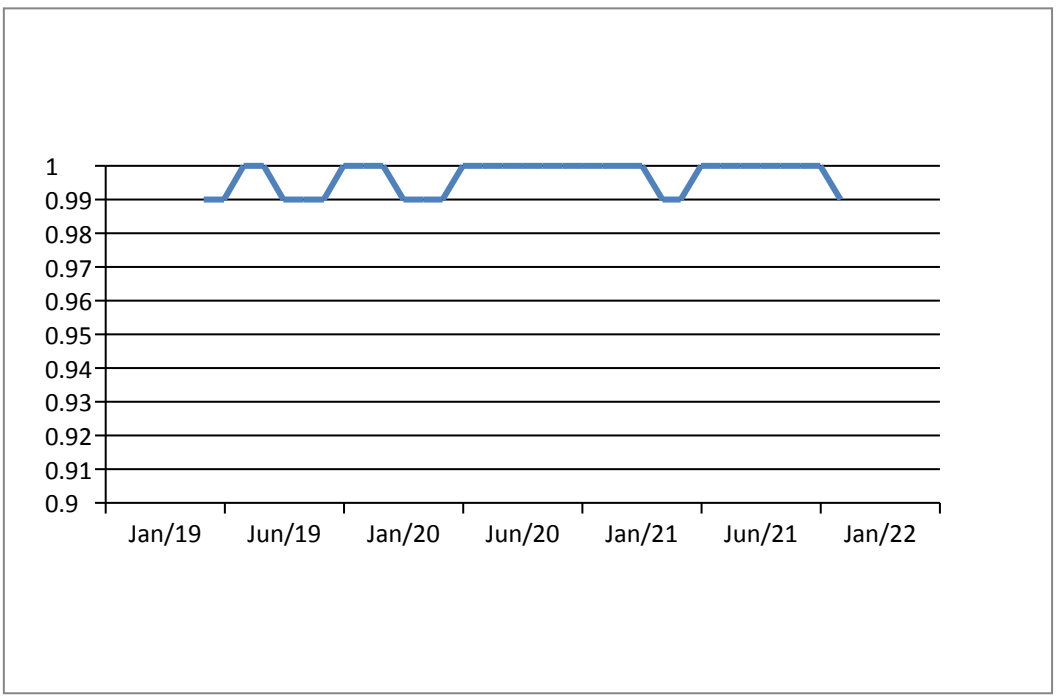
6.5 PF (Power factor)

Introduction:

Power Factor is an expression of energy efficiency. It is usually expressed as a percentage—and the lower the percentage, the less efficient power usage is. Power factor (PF) is the ratio of working power, measured in kilowatts (kW), to apparent power, measured in kilovolt amperes (KVA).

Study: We have tabulated power factor value of three years on monthly basis.

Month	Year - 2019	Year - 2020	Year - 2021
January	-	0.99	1
February	-	0.99	0.99
March	0.99	0.99	0.99
April	0.99	1	1
May	1	1	1
June	1	1	1
July	0.99	1	1
August	0.99	1	1
September	0.99	1	1
October	1	1	1
November	1	1	0.99
December	1	1	-



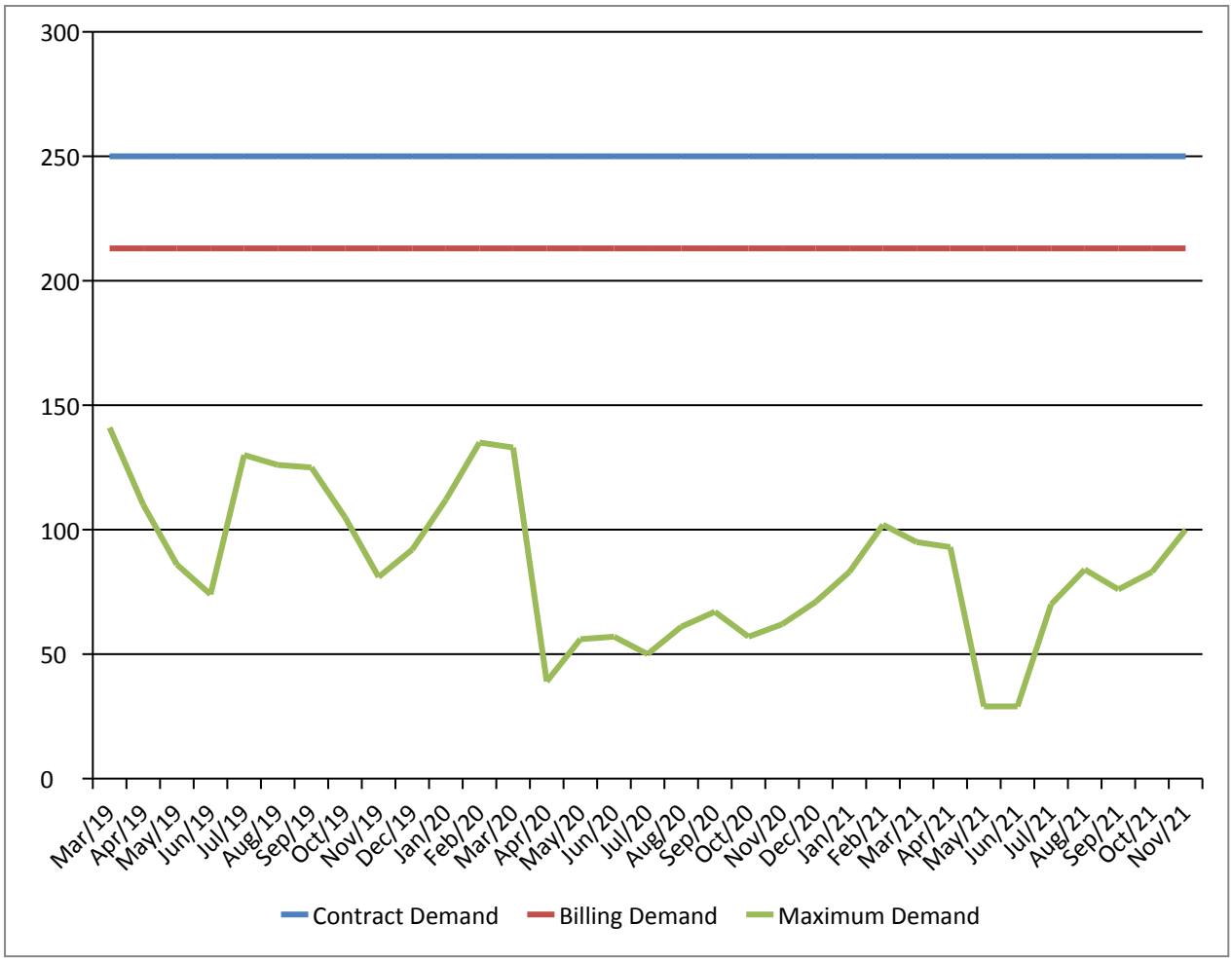
Remark: Institution has maintained excellent power factor of 0.99 to unity.

6.6 MAXIMUM DEMAND (MD)

Maximum demand is the highest level of electrical demand monitored in a particular period. All HT consumers will have contract demand with ESCOM based on their load. ESCOMS will bill the consumer at 85% of contract demand and maximum demand recorded by meter, whichever is higher. Study: based on ledger extract of CHESCOM, we have tabulated maximum demand for four years as below.

month/year	Contract Demand	Billing Demand	Maximum Demand	Excess KVA	EXCESS AMOUNT
Mar-19	250	213	141	72	16790.4
Apr-19	250	213	110	103	24019.6
May-19	250	213	86	127	29616.4
Jun-19	250	213	74	139	32414.8
Jul-19	250	213	130	83	19355.6
Aug-19	250	213	126	87	20288.4
Sep-19	250	213	125	88	20521.6
Oct-19	250	213	105	108	25185.6
Nov-19	250	213	81	132	30782.4
Dec-19	250	213	92	121	28217.2
Jan-20	250	213	112	101	23553.2
Feb-20	250	213	135	78	18189.6
Mar-20	250	213	133	80	18656
Apr-20	250	213	39	174	40576.8
May-20	250	213	56	157	36612.4
Jun-20	250	213	57	156	36379.2
Jul-20	250	213	50	163	38011.6
Aug-20	250	213	61	152	35446.4
Sep-20	250	213	67	146	34047.2
Oct-20	250	213	57	156	36379.2
Nov-20	250	213	62	151	35213.2
Dec-20	250	213	71	142	33114.4
Jan-21	250	213	83	130	30316
Feb-21	250	213	102	111	25885.2
Mar-21	250	213	95	118	27517.6
Apr-21	250	213	93	120	27984
May-21	250	213	29	184	42908.8
Jun-21	250	213	29	184	42908.8
Jul-21	250	213	70	143	33347.6
Aug-21	250	213	84	129	30082.8
Sep-21	250	213	76	137	31948.4
Oct-21	250	213	83	130	30316
Nov-21	250	213	100	113	26351.6

Graph of Contract demand, Billing demand, recorded maximum demand in kva v/s month & year



Remarks:

As per the three years electricity bill, we have recognized that the institution has taken 250 KVA contract demand but they are using below 150 KVA and Cheskom is billing for 213 KVA.

Recommendation:

1) Institution may reduce 50 KVA contract demand. This will reduce about Rs 10,000/- in mothly electricity bills .
2) If campus is planning to install Solar roof top in near future, it not recommended to reduce contract demand. (ref Chapter9 – Renewable energy) .

6.7 Category of connected load & impact on source

Loads are classified on different category based on their function and electrical characteristics. They have different impact on the electrical system.

SL	Category of load	Total Wattage	% load	Remark
A	Illumination with Regular tubes & CFLS	52649	27.094	low PF non surge
B	LED lighting	3020	1.554	high PF ,non surge
C	Fans of all types	33035	16.999	med PF, non surge
D	Air conditioning ,fridge, freezer	17090	8.794	med PF, surge
E	Computers, IT & peripherals ,lab equipments thro UPS)	88510	45.547	Med PF, non surge
F	PUMPS (motor load) RO	9	0.005	Med PF , surge
G	Miscellaneous	15	0.008	Med PF ,NON surge
	Total	194328	100.000	

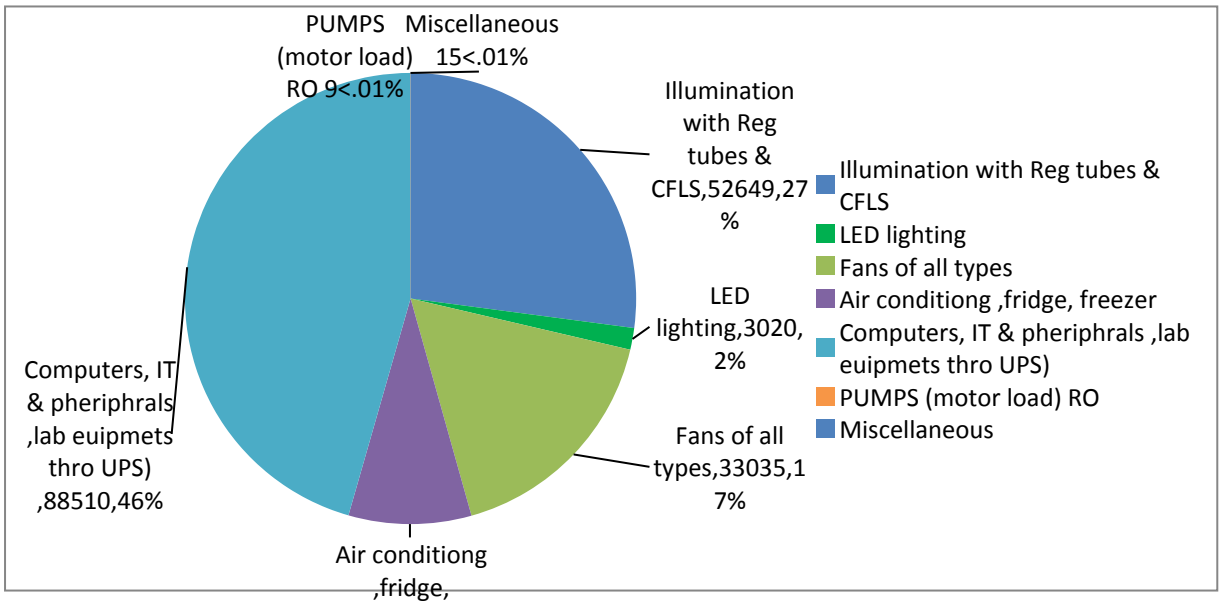
Note

NOTE:
Low PF 0.6 & below
Medium PF - 0.6 to 0.8
High PF 0.8 to 1.0
Non surge - regular staring current
Surge load - 3to 5 times starting current

Impact on grid:

Load characteristics	Impact on system
Low PF & surge	Very high
Medium PF & surge	High
Low PF & non surge	Medium
High PF & Non surge	Nil

PIE chart



Concluding remark:

- Consumer does not have any such load , which will have impact on grid.
- There are certain equipments such as UPS, Air conditioners, old tubes which have low to medium power factor. But automatic power factor capacitors have corrected power factor to near unity. .

7. POWER QUALITY

7.1 Introduction Power quality

Power quality refers to the ability of electrical equipment to consume the energy being supplied to it. A number of power quality issues including electrical harmonics, poor power factor, voltage instability and imbalance impact on the efficiency of electrical equipment.

This has a number of consequences including:

- Higher energy usage and costs
- Higher maintenance costs
- Equipment instability and failure

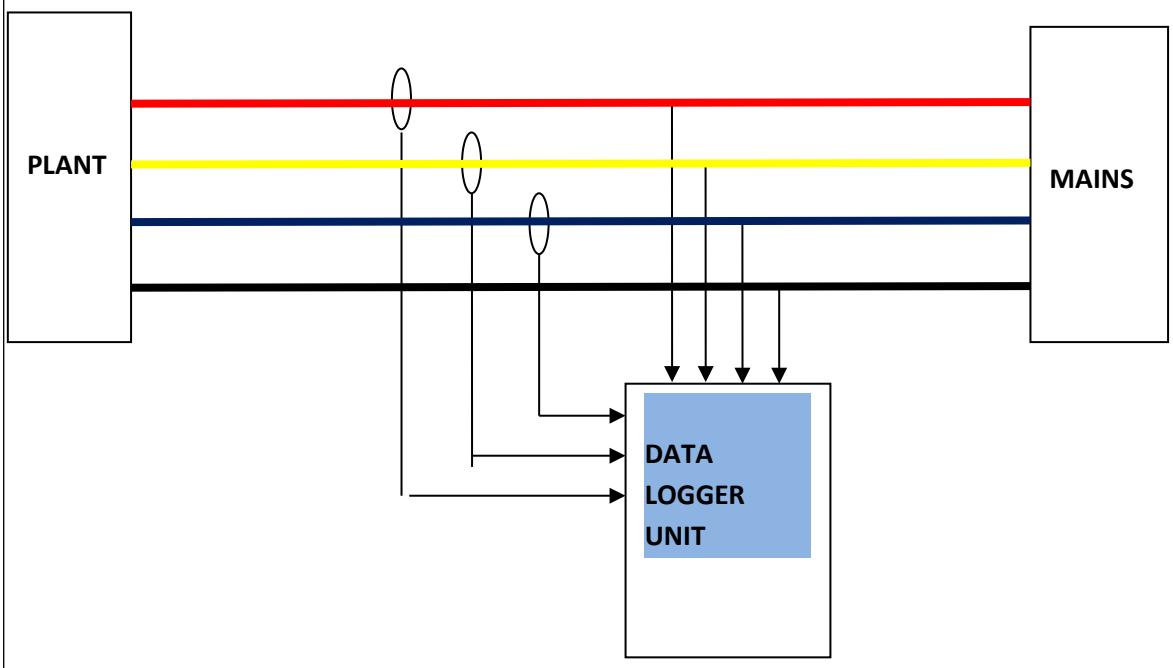
Energy management is an important consideration for any business, and it is critical that power quality be assessed as part of any energy management strategy.

Common Power quality problems includes Voltage variations, Voltage un balance, Power factor, Load unbalance

Your campus has dedicated transformer with 3phase supply and majority loads are ingle phase, there are chances of any of above issues. Power quality analysis will study above parameters for minimum 72 hours using advanced data log & soft ware tools more precisely. Samples bearing collected every minute basis for more accurate results

Power data logger , an advanced device

To analyse power parameter such as voltage, current, power factor ,kw variation on each phase, we installed a data logger. It collects all data at sampling rate one minute. Data logger was fixed on mains side as below.



Followings graphs were platted based on data collected:

1)Loading (power) on R, Y , B phase

2)Total power on each phase

3) Power variation on ach phase & total

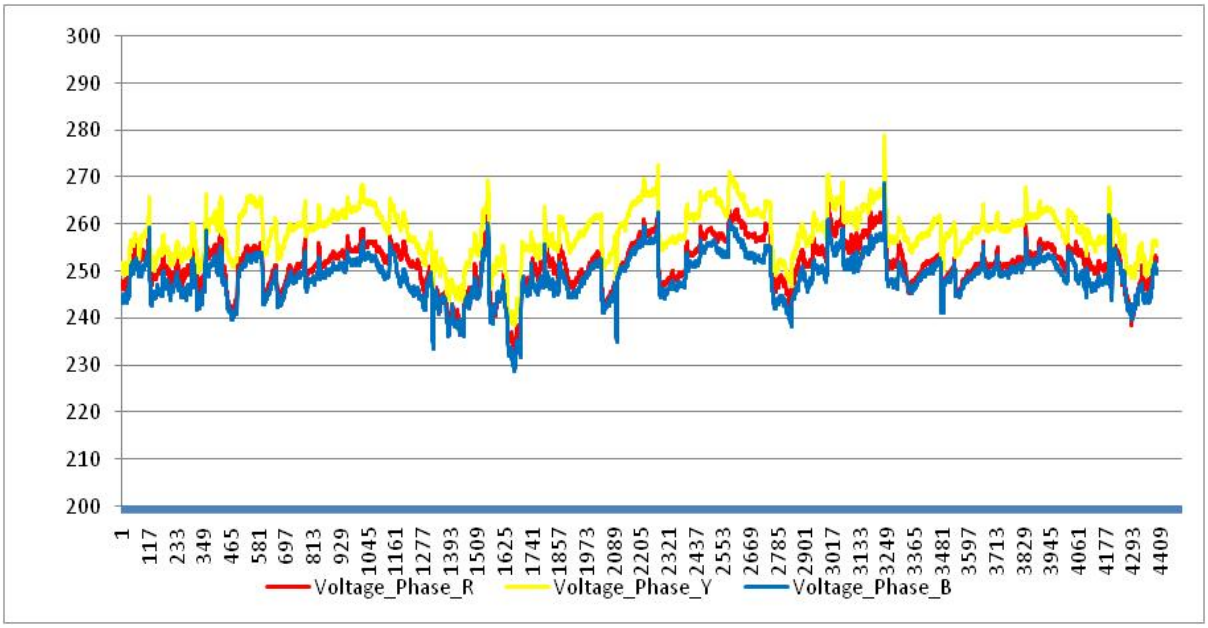
4) voltage variation on each phase

5) power factor variation

6) Energy consumption

NOTE; Your new building had necessary facility to connect data log. But old building did not had necessary facility to connect data logger unit. So we recorded main power parameters of old building using power analyser by frequent visits.

7.2 Voltage variation

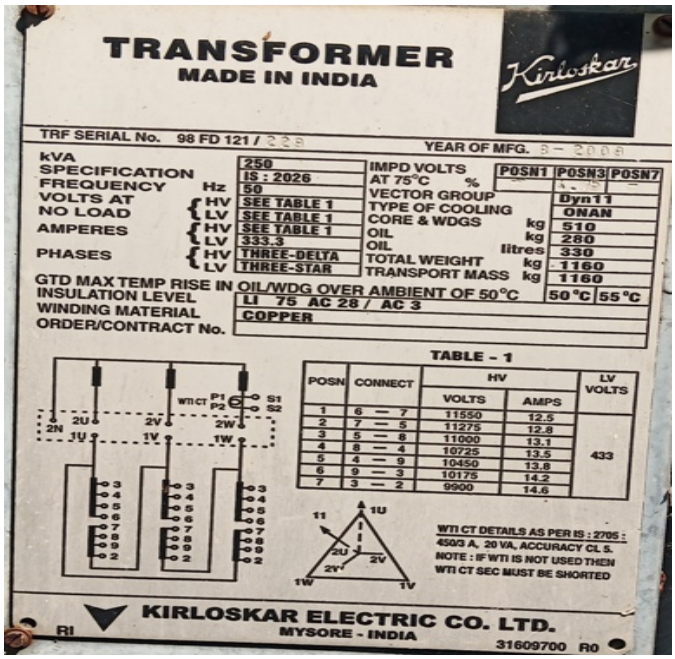


Remark:

1)Most of equipments run on single phase , hence voltage on each phase is plotted.

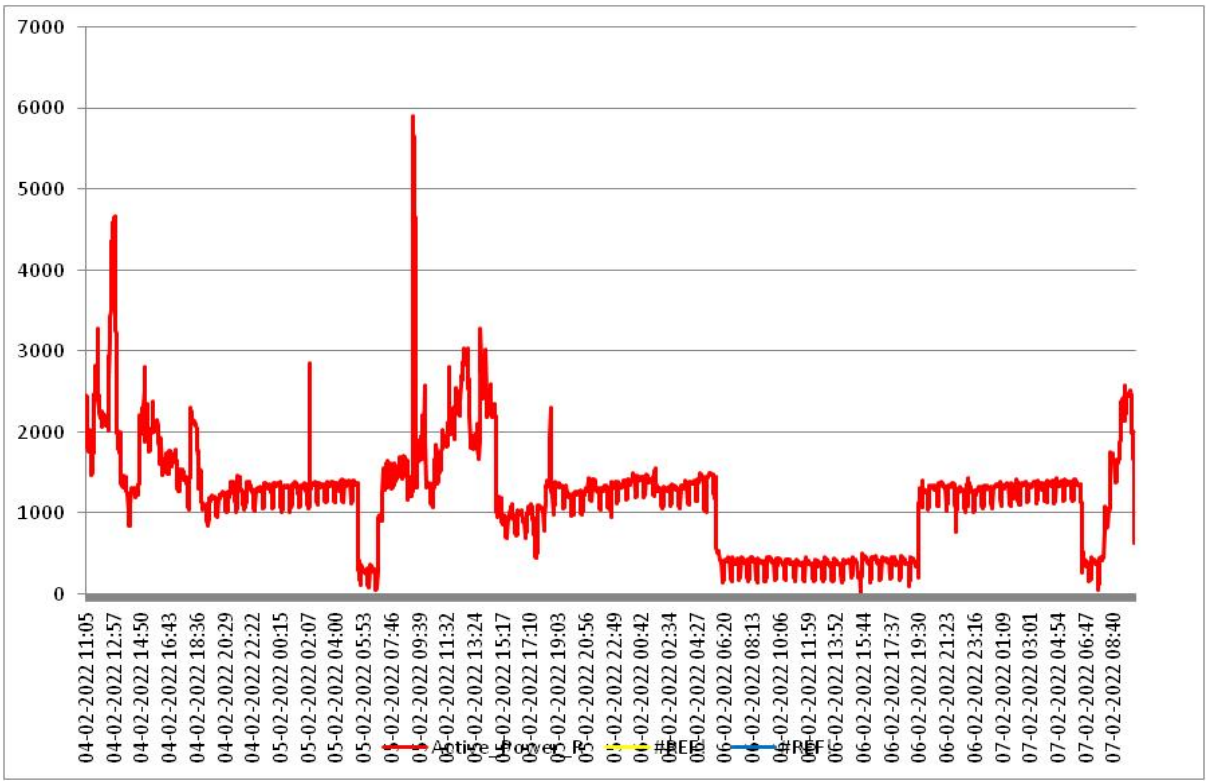
Voltage is higher on each phase. Voltage between 220 -240 is suitable for your application. But voltage is between240-260 volts most of time. However most of sophisticated equipments used in college is connected through UPS. Working range of UPS will be 170Vac to 270VAC. Above voltage variation will not have much impact.

2)Entire campus is connected to one single transformer of 250 kva. Transformer has tap changing facility (ref chapter 6.3 transformer). By using tap changer voltage level can be reduced.

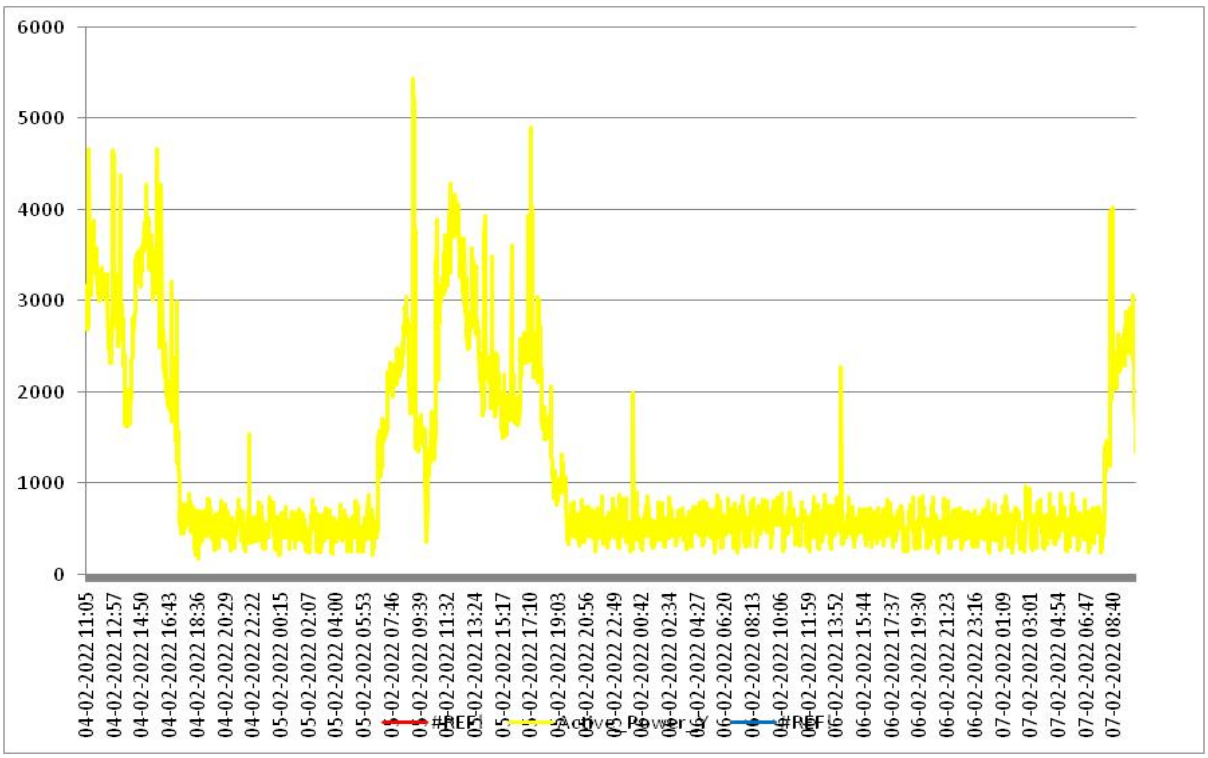


7.3 Load variation

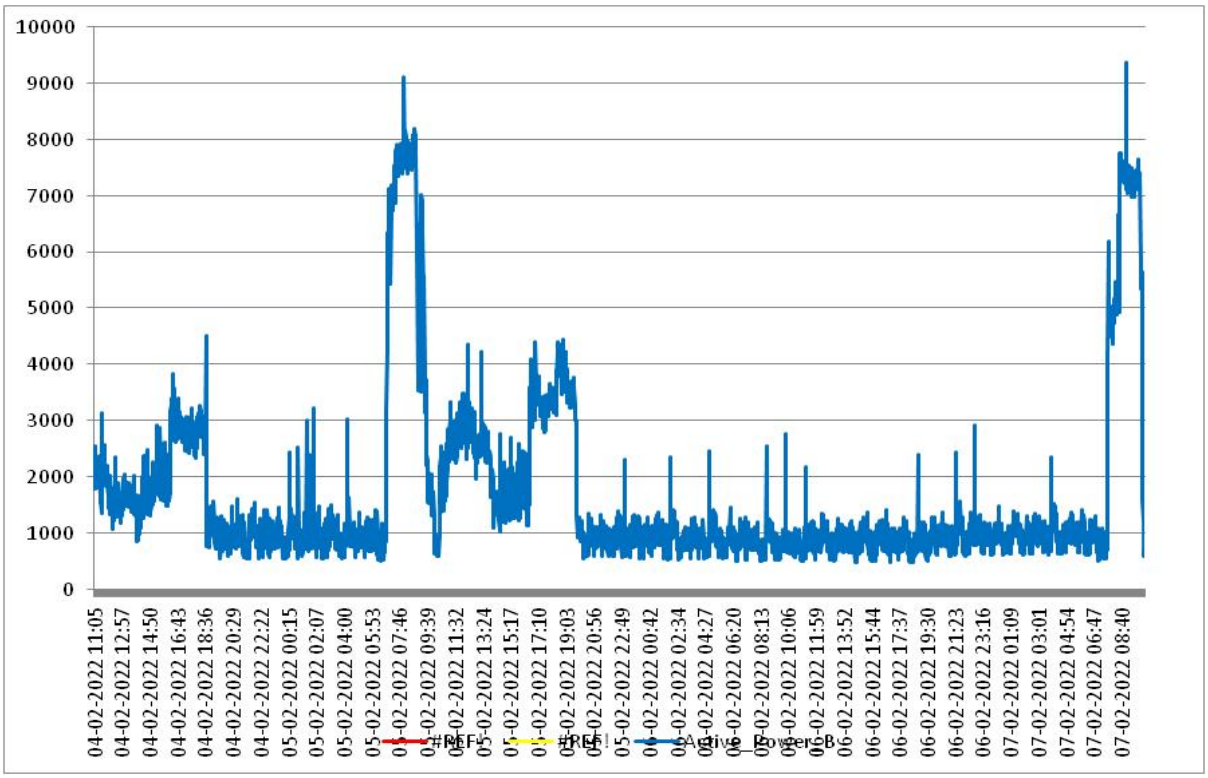
(a)R phase power variation from 4/2/22 to 7/2/22 (watt v/s Date& time)



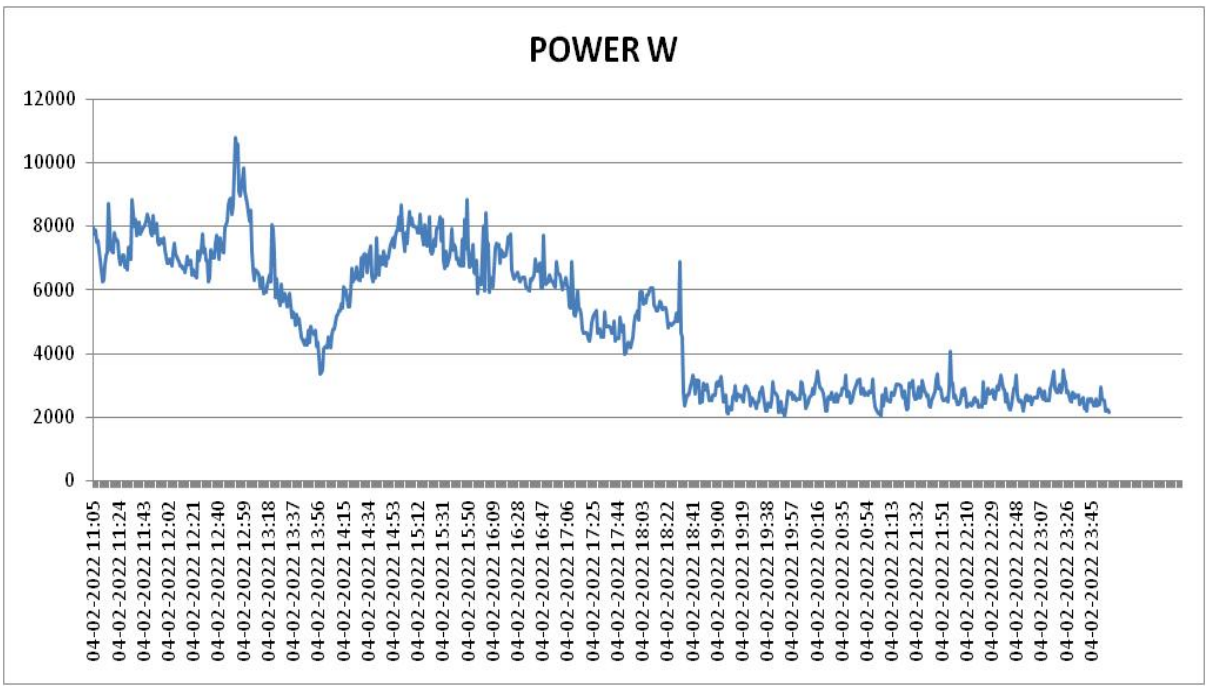
(b)Y phase power variation from 4/2/22 to 7/2/22 (watt v/s Date& time)



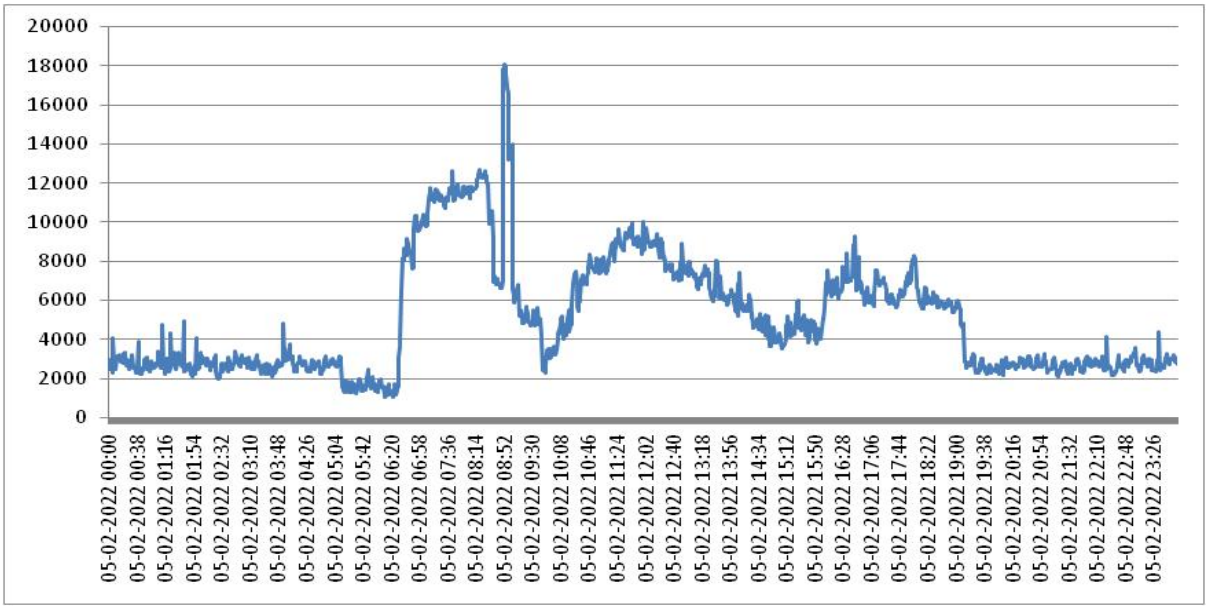
(c) B phase power variation from 4/2/22 to 7/2/22 (watt v/s Date& time)



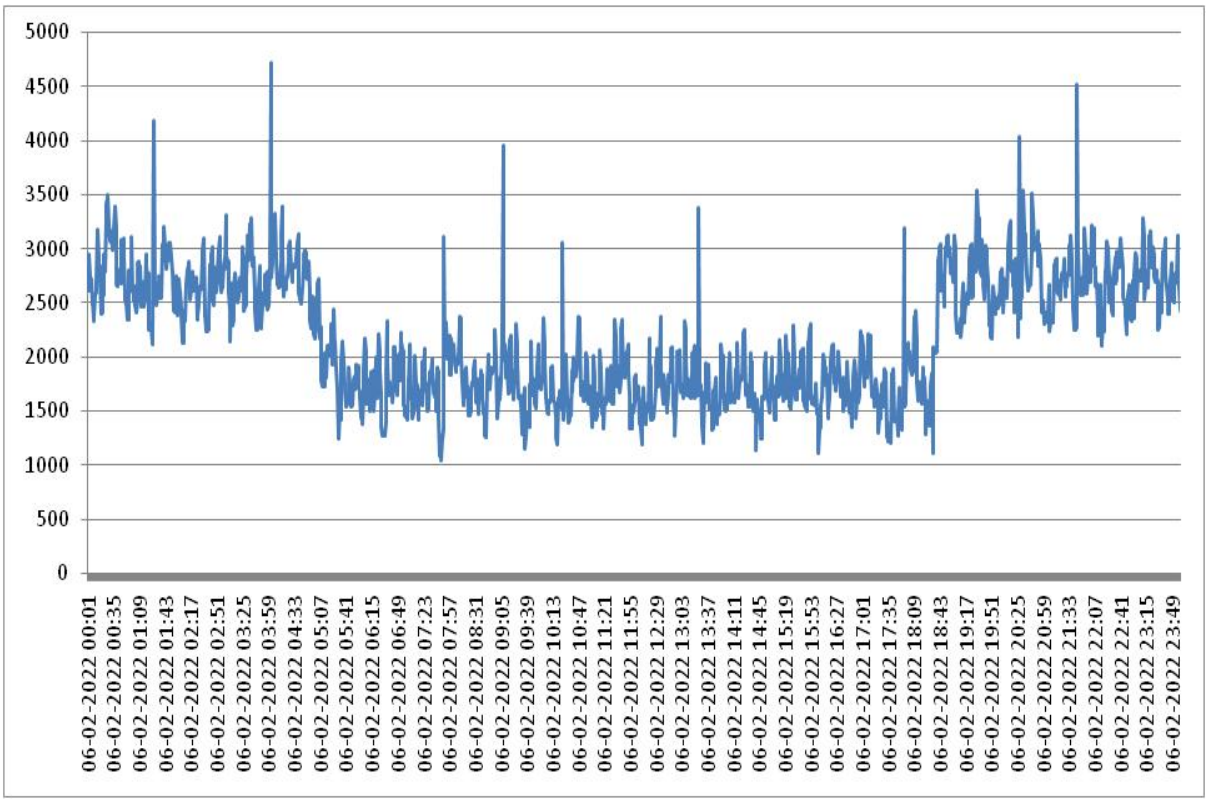
(d) Total Power consumption (including all three phases) on 4th feb 2022



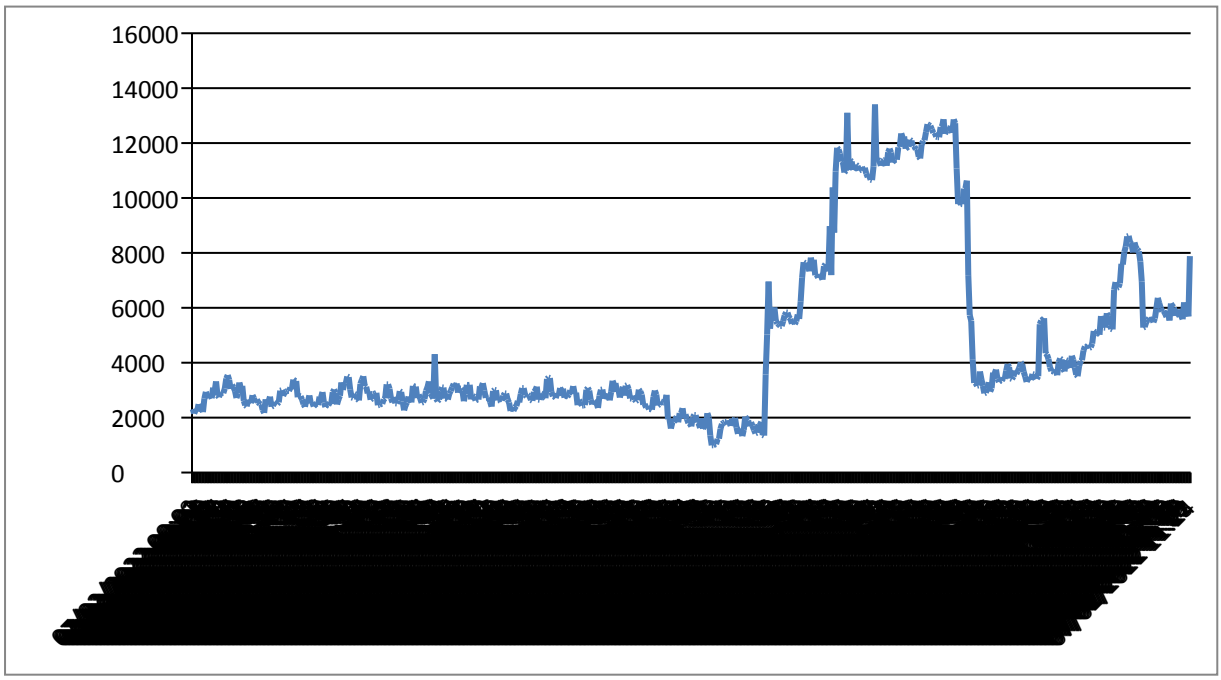
(e)Total Power consumption (including all three phases) on 5th feb 2022



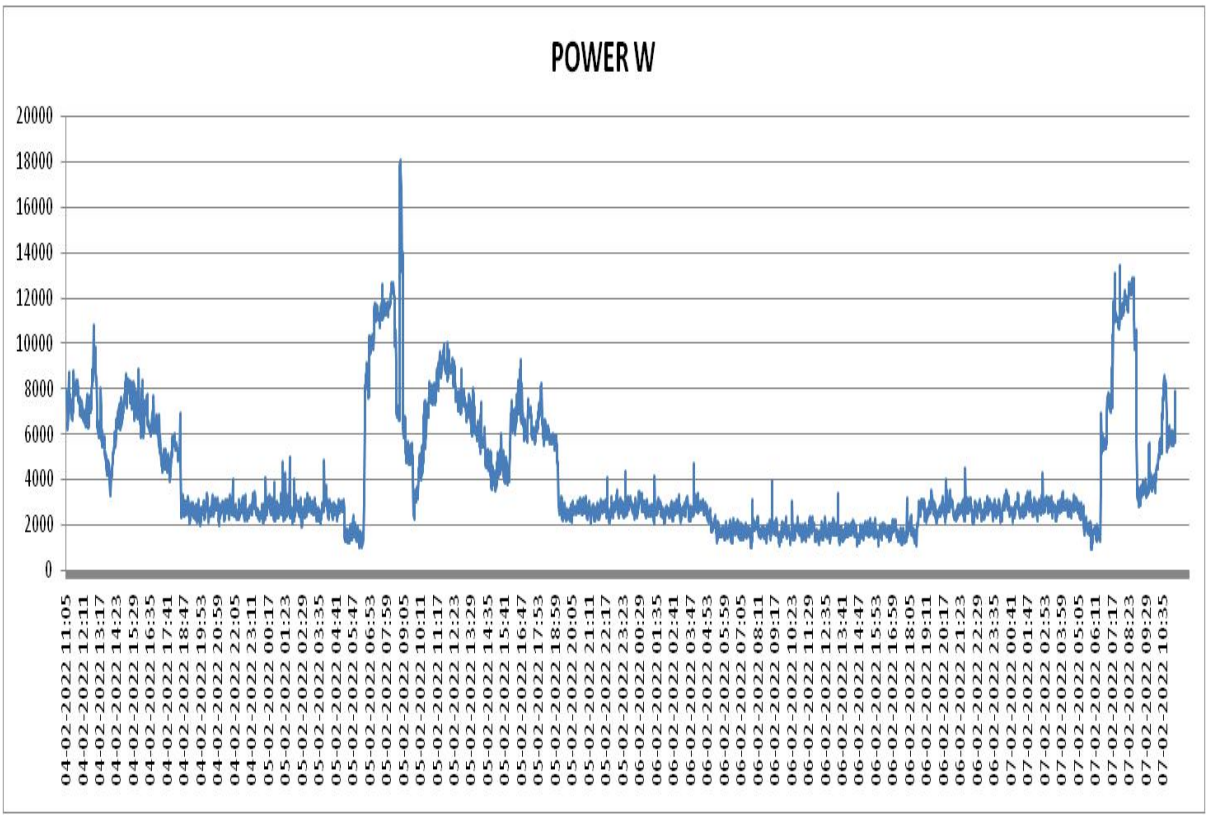
(f)Total Power consumption (including all three phases) on 6th feb 2022



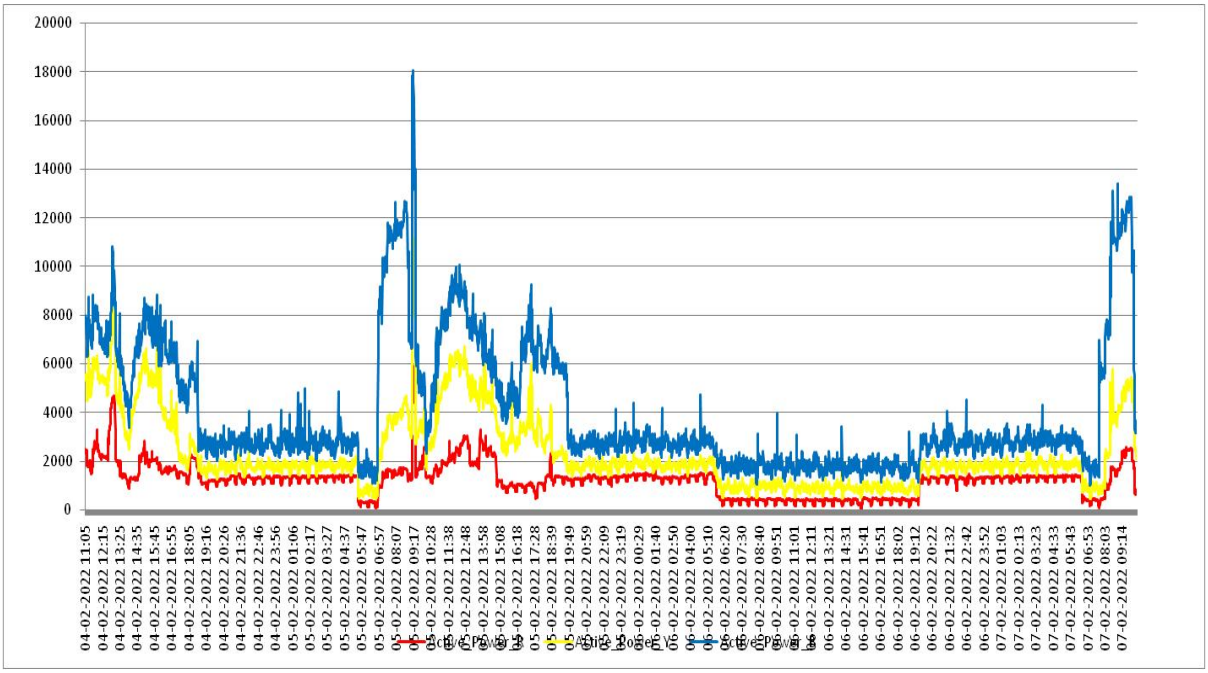
(g)Total Power consumption (including all three phases) on 7th feb 2022



(h)Total Power consumption (including all three phases) on 4th to 7th feb 2022



(i)Total Power consumption (including all three phases) on 4th to 7th feb 2022 (in all three phases)



Phase	R	Y	B	total
Minimum W	162.0573	175.6036	487.9177	990.9067
Maximum W	5913.176	5442.825	9368.284	18061.99
Average W	1222.566	1152.275	1672.354	4047.169

Observation & remark:

- Above graphs are related to new building panel. Old building did not had facility to install data logger.
- There is load un balance in loading on each phase. Blue phase has more load and Red has less load. This will be common in single phase and varying loads. But power on any phase has not crossed any safety limit. Leakage current in neutral is also with in safety limit.

7.4 Energy consumption on different days

(a)New building energy consumption recorded by digital data logger

Average power Friday / Monday (4th & 7th feb2022)	Average power Saturday (5th feb 2022)	Average power Sunday (6th feb2022)
4752.167	5050.741	2178.574
Energy Friday / Monday	Energy Saturday	Energy Sunday
114.052	121.217	52.285
	Total energy for 3 days	287.555

(b)For monthly consumption based on manual data reading at different time interval
(ref chapter TOD)
Calculate based on above for old building

Duration	8 hours	16 hours
Power Average (w)	7000	3000
Energy KWH	56	48
Total KWH (units)	104	per day

(c) Estimated energy consumption per month

	New building KWH (UNITS)	Old building KWH (UNITS)	Total/day KWH (UNITS)	No of days per month	Total KWH (UNITS)
Normal working day	121	104	235	25	5875
Sunday /holiday	52	30	82	5	410
Additional consumption by any event, programs ,etc KWH (UNITS)					715
Estimated energy consumption per month KWH (UNITS)					7000

(d)Peak power consumption (maximum demand)

Old building	11 KW
New building	12 kw
Total	22kw

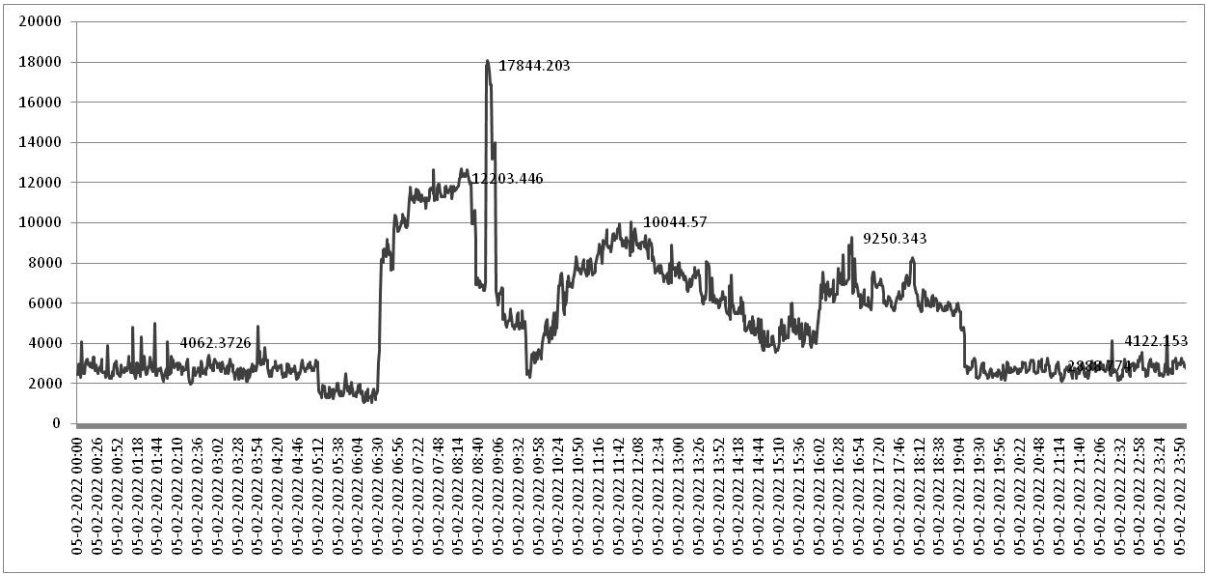
SAY 25 KW (Momentary surge load is not considered)

7.5 TOD ENERGY

TOD (Time of Day) is the term used in energy sector for defining energy consumption on dieerent time of day. It will be usually divided in to four zones or as per need.

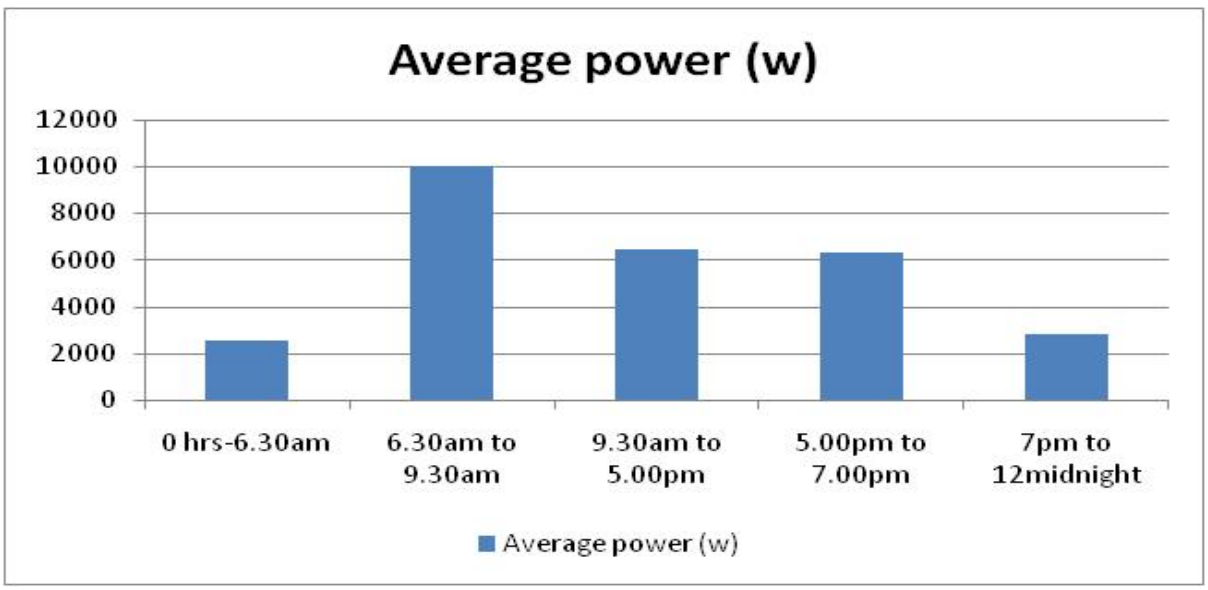
(a) NEW BUILDING

Following graph gives variation on working day 5th feb 2022 Saturday

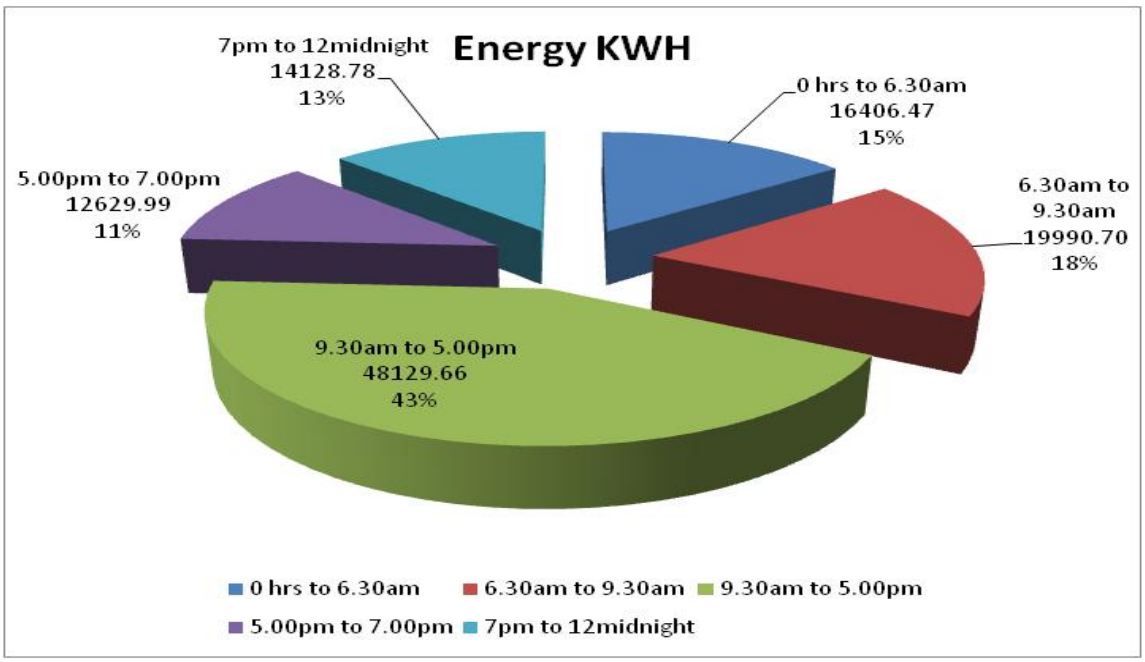


TOD	0 hrs-6.30 am	6.30am to 9.30 am	9.30 am to 5.00pm	5.00pm to 7.00pm	7.00pm to 12midnight
Average Power (w)	2524.072	9995.351	6417.288	6314.996	2825.757
Energy KWH	16.406	19.990	48.129.	12.629	14.128
%	15%	18%	43%	11%	13%

Total 111.285 kwh per day



Energy

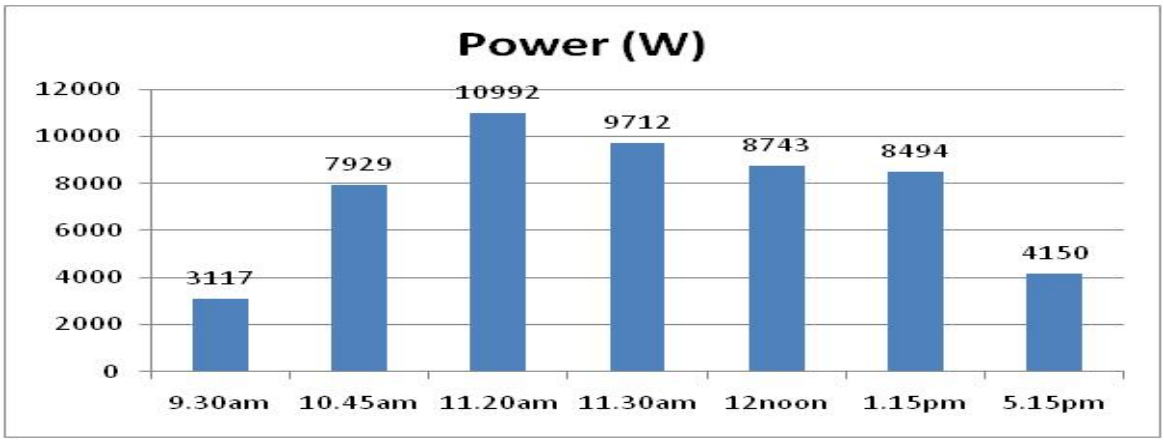


(b) OLD BUILDING;

Date	Time			Total Power(W)
01-02-2022	01:15 PM			
	R	Y	B	
Voltage	238.5	242.6	239	
Current	10.9	11.4	17.8	
PF	0.87	0.9	0.88	
Power (w)	2261.70	2489.08	3743.70	8494.47
Date	Time			
02-02-2022	10:45 AM			
	R	Y	B	
Voltage	231.8	237.3	235.3	
Current	12.9	7.73	18.72	
PF	0.78	0.89	0.9	
Power (w)	2332.37	1632.55	3964.33	7929.26
Date	Time			
02-02-2022	12:00 PM			
	R	Y	B	
Voltage	233.3	237.2	235.9	
Current	12.47	4.76	23.98	
PF	0.84	0.82	0.95	
Power (w)	2443.77	925.84	5374.04	8743.65
Date	Time			
02-02-2022	05:15 PM			
	R	Y	B	
Voltage	245.6	249.5	243.6	

Current	3.45	5.88	10.1	
PF	0.79	0.83	0.92	
Power (w)	669.38	1217.66	2263.53	4150.57
Date	Time			
03-02-2022	09:30 AM			
	R	Y	B	
Voltage	244.6	249.1	244.6	
Current	2.61	4.95	6.81	
PF	0.79	0.89	0.91	
Power (w)	504.34	1097.41	1515.81	3117.56
Date	Time			
04-02-2022	11:20 AM			
	R	Y	B	
Voltage	238.6	242.6	240.6	
Current	17.11	13.3	26.28	
PF	0.69	0.77	0.9	
Power (w)	2816.89	2484.47	5690.67	10992.03
Date	Time			
05-02-2022	11.30am			
	R	Y	B	
Voltage	235.3	243.9	237.9	
Current	13.93	12.45	21.53	
PF	0.8	0.8	0.91	
Power (w)	2622.18	2429.24	4661.01	9712.44

Graph

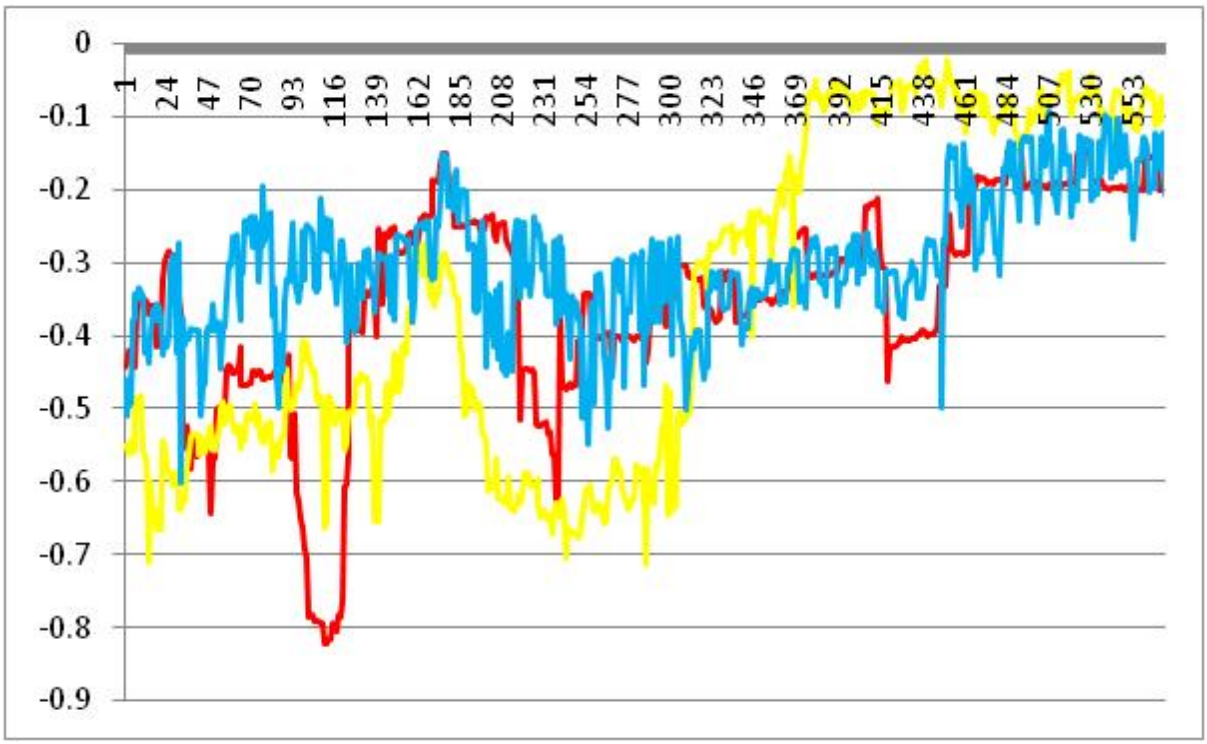


Energy of old building

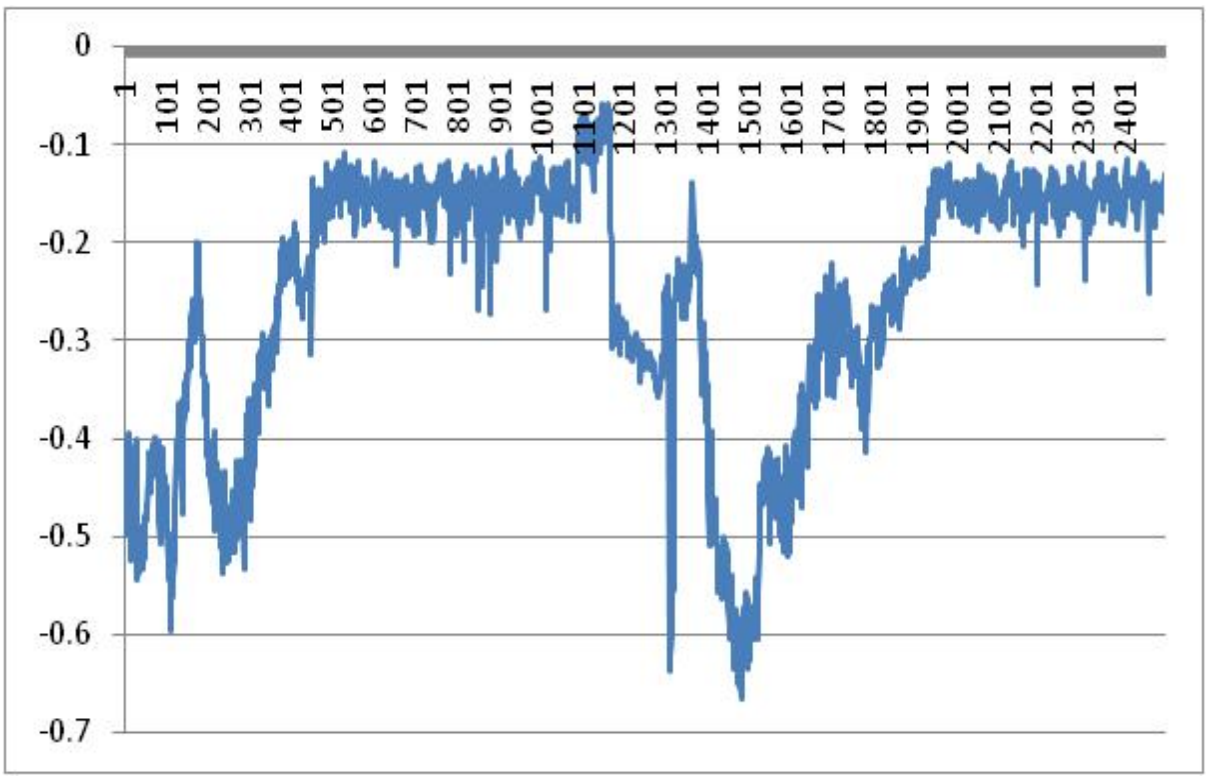
Duration	8 hours	16 hours
Power Average (w)	7000	3000
Energy KWH	56	48
Total KWH (units)	104	per day

7.6 PF variation

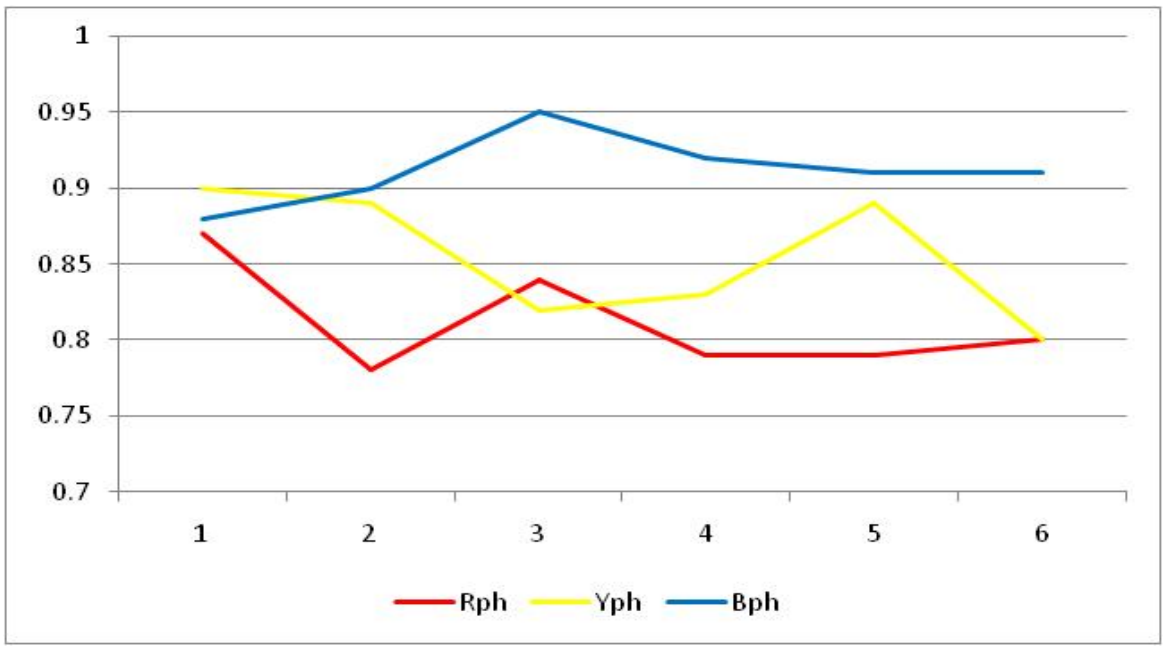
(a) Phase wise PF variation in new building



(b)Total PF variation in new building



(c) PF variation in Old building



Remark:

- Institution has majorly inductive load such as old tube lights, fans & UPS.
- Old building has lagging power factor. New building has lading power factor. In over all the entire premises has maintained good power factor.
- Over rated PF capacitor in new building can be reduced to unity by decreasing capacitor value. In general central power factor correction panel is most suitable for your type of application.

Image of capacitor at new building panel board .

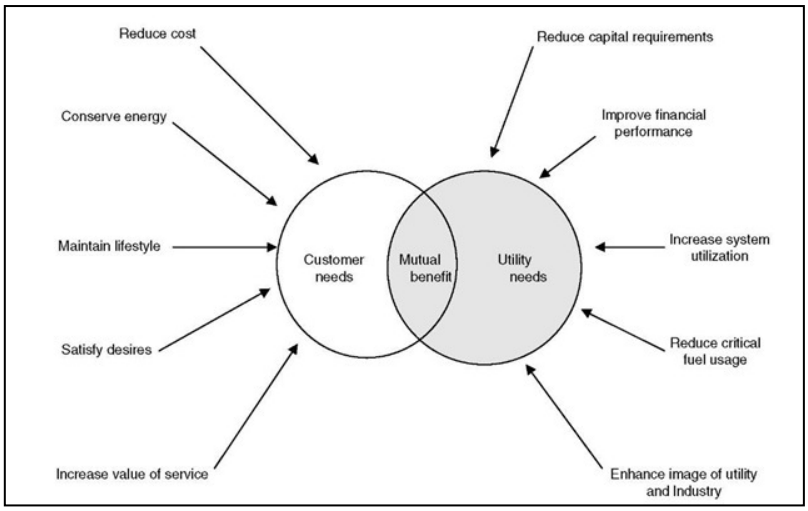
8 DEMAND SIDE MANAGEMENT(DSM)

8.1 Introduction : Demand Side Management (DSM) has been traditionally recognized as one of the major intervention to achieve reduction in energy demands while ensuring continuous development. In recent past, DSM has gained unprecedented importance and has become an integral part of almost all the central and state missions on promotion of Energy Efficiency. DSM interventions have helped utilities not only to reduce the peak electricity demands and but also to defer high investments in generation, transmission and distribution networks.

Demand-side management is the active planning and implementation of programs that will change consumers' use of electricity. These programs may encourage the adoption of more efficient appliances, the use of new technologies, and the time these and other devices are used.Demand-side management programs result from the planning and implementation of those activities designed to influence consumer use of energy in ways that will produce desired changes in the time pattern and magnitude of energy demand. Programs and initiatives falling under the umbrella of demand-side management include load management, new uses, strategic conservation, electrification, and adjustments in the market share of energy-consuming devices and appliances.

In simple way, DSM is analysing the load , equipment efficiency, sizing and usage pattern to optimise energy consumption. However while implanting any changes no compromise has to be made in safety, productivity and comfort level. Amount of investment , pay back period (ROI- Return on investment) amount of waste generation & pay back period will be given due preference.

Demand side management to achieve ENCON (energy conservation) is major and critical phase of any comprehensive energy audit. Such recommendation will be outcome of knowledge, experience, expertise and creativity of audit team



8.2 Details of connected load type, power and statistics in the institution

This chapter is cumulative information of all types of connected load.

Sl no	TYPE OF LOAD	Nos	wattage	Total wattage	% Load
1	Magnetic choke regular Tube	1207	40	48280	24.84459
2	Magnetic choke slim Tube	35	36	1260	0.648388
3	CFL luminary 60 W (2ftX2ft 3 CFL set)	36	60	2160	1.111523
4	Focus Light 100w	2	100	200	0.102919
5	Concealed Round lamp 9 W	82	9	738	0.37977
6	LED Tube	102	20	2040	1.049772
7	Yard light LED	12	20	240	0.123503
8	LED fitting 6inX6in 20 W +bulb	12	20	240	0.123503
9	CFL	1	11	11	0.005661
10	LED luminary	25	20	500	0.257297
11	Ceiling fan Fan (very old)	17	85	1445	0.743588
12	Ceiling fan (old)	376	70	26320	13.54411
13	Ceiling fan (new)	30	55	1650	0.84908
14	Wall Fan	54	60	3240	1.667284
15	Exhaust Fan	4	50	200	0.102919
16	Pedestal Fan	3	60	180	0.092627
17	Projector	30	500	15000	7.718908
18	Computer System	183	200	36600	18.83414
19	Printer with scanner	39	750	29250	15.05187
20	Fridge	20	200	4000	2.058376
21	Freezer	3	350	1050	0.540324
22	Xerox	5	1500	7500	3.859454
23	TV (old + new) 60+80	2	70	140	0.072043
24	Split Air conditioner	8	1500	12000	6.175127
25	Central air conditioner (4 compressors)	1	40	40	0.020584
26	pumps (2 reg + borewell)	3	3	9	0.004631
27	Lab equipments	L/s	avg	20	0.010292
28	Misc (CCTV,RO,UPS CHARGING, etc)	L/S	avg	15	0.007719
	TOTAL CONNCTED LOAD (watt)			194328	100%
	UPS CAPACITY	24	98450	kva	
	Loads wattage are taken as average				

8.3 Load Distribution (Section wise)

Room	OT *	SOT *	Fancy CFL 60W	100W FL*	CRB * 9W	LED Tube	LED Fix *	CFL	*FL Light	V.OCF*	OCF *	NCF *	Wall Fan	Ex Fan *	*S. Fan	Projector	System	Printer scanner	Fridge	Freezer	Xerox	UPS Capacity	TV	A/C
AO Chamber	2												1				1							
PriclAnti Chamber	3	1									1						1	1				1050VA /12VDC	1 (Old)	
Principal Chamber	2					4					2				1/ Old		1	1					1(LCD)	
Society	3														1/ Ol									
Office	9									1	1		5				11	11			2			
Ladies Room	5										1				1							10000VA /180VDC		
Language Lab	4										5						3	2				5000VA /120VDC		
CB Building	304										96													
RB Rooms						60						24												
Class Room Old Building	20										12					1								
Ground Floor	1	3																						
Lecture Hall	3										2													
Room No. 38	12										4					1								
NB Building	84										28					7	7							
NB Building Corridor	21																							
Examination Section	47										10						7					5000VA/120VDC		
Botony Hall	12										10					2								
Electronics	6										4					1								
MicroBiology Lab 1	16										7								1					
MicroBiology Lab 2	14										5					1			2	1				
Staff Room	16							1-			5						3	2				5.2kva/72		

								11w																	

OT*- Old Tube SOT* -Small Old Tube FL* - Focus Light CRB* - Conceiled Round Bulb Led Fix* - Led 1/2 Feetx1/2 Feet *FL Light - Fancy Led Light
V.OCF* - Very Old Ceiling Fan OCF* - Old Ceiling Fan NCF* - New Ceiling Fan EX Fan*- Exhaust Fan *S Fan - Stand Fan

Room	OT	SOT	Fancy CFL 60W	100 W FL	CRB 9W	LED Tube	LED Fix	CFL	FL Light	V.OCF	OCF	NCF	Wall Fan	Ex Fan	S. Fan	Projector	System	Printer scanner	Fridge	Freezer	Xerox	UPS Capacity	TV	A/C
ComputerScienceCS/1	18										6						20					5000VA /48VDC		
ComputerScienceCS/2	12										6						30					5000VA /72VDC		
BioChemistry Lab 1	20										6													
BioChemistry Lab 2	14										6			4					1	1		5000VA /72VDC		
Biochemistry Staffroom	16										3						2	2						
Biotec Lab 1	16										4			2					1			3000VA /48VDC		
Biotec Lab 2	14										6								1					
Biotec Staff Room	16										4						1	1						
Molecular Biology Lab 1	18										3					1	1		1	1		1000VA /12VDC		
Molecular Biology Lab 2	14										6					1			3			2000VA /48VDC		
Electronics Lab	12										6					1	3					5000VA /72VDC		
HOD Chamber	4										1						1	1						
Botony	12										6					3								
Botony Corridor	3																							
Botony HOD Chamber	4										2						1	1						
Sangrahalaya	12									4														
Firstfloor Practicalhall	11									2						1								
Practicalpreparationhall	1									1				1										
Practical Hall 1	11									2						1			1					
Staff Room	13									5							4	4						1
Botony PG(Electronics)		4									2						2	2						

OT*- Old Tube SOT* -Small Old Tube FL* - Focus Light CRB* - Conceiled Round Bulb Led Fix* - Led 1/2 Feetx1/2 Feet *FL Light - Fancy Led Light
V.OCF* - Very Old Ceiling Fan OCF* - Old Ceiling Fan NCF* - New Ceiling Fan EX Fan*- Exhaust Fan *S Fan - Stand Fan

Room	OT *	SOT *	Fancy CFL 60W	100 W FL*	CRB * 9W	LED Tube	LED Fix*	CFL	*FL Light	V.OCF *	OCF *	NCF *	Wall Fan	Ex Fan *	*S. Fan	Projector	System	Printer scanner	Fridge	Freezer	Xerox	UPS Capacity	TV	A/C
Class Room 1		12									4													
Class Room 2		4									2													
Botony 2nd floor Lab 3	3					9						6				1	1							
Serculture Room 1	6										4					1	1		1					
Hod Room	3										2						1							
Serculture Practical Hall	10										5					1			2			3000VA /48VDC		
Zoology Lab 1	9										5		1			1	3				1	5000VA /72VDC		
Asha Devi Madam Room	1										2						1	1	1					
Environmental Biology Lab	7										1						3							
Zoology Museum	4																							
HOD Room	3										1						1		1					
Zoology Practical Hall 2	5										2					1	1					3000VA /48VDC		
Class Room	5										4					1	1							
Kannada Staff Room	2												1				1	1						
Geology	10										4						4	2						
Geology Lab	4										3						1							
Geology Museum	6										3													
Geology Lab 2	4										2											Faulty		
Geology Lib	8										2													
Geology Remote Sen. & G/S Lab	14										3						8							
Envirl Science	10										5											2kva/48		

																						v		

OT*- Old Tube SOT* -Small Old Tube FL* - Focus Light CRB* - Conceiled Round Bulb Led Fix* - Led 1/2 Feetx1/2 Feet *FL Light - Fancy Led Light
V.OCF* - Very Old Ceiling Fan OCF* - Old Ceiling Fan NCF* - New Ceiling Fan EX Fan*- Exhaust Fan *S Fan - Stand Fan

Room	OT *	SOT *	Fancy CFL 60W	100 W FL*	CRB * 9W	LED Tube	LED Fix*	CFL	*FL Light	V.OCF *	OCF*	NCF *	Wall Fan	Ex Fan *	*S. Fan	Projector	System	Printer scanner	Fridge	Freezer	Xerox	UPS Capacity	TV	A/C
Mathematics Staff Room	6										3						2	2			1	1500VA /24VDC		
Mathematics Lab	2										2					1	25					5200VA /72VDC		2
Statistics Laboratory									25no 2ft								21	2				5000VA /72VDC		3
Board Room	4										4					1								2
BSE 1st Floor Lab 1	6					1					3								1					
Staff Room	3					1					2						1	1						
Physics Staff Room	3					1					2													
HOD Room	2										1						1	1						
Einstein Hall	6										2					1								
BSE 2nd year Lab		6									3													
Physics Lab 3	7										2Faulty											5kva/72		
Physics Lab 4	7										2													
MSE Lab	6												3											
Chemistry Ladies Staff Room	1										1													
Chemistry Gents Staff Room	3	2				1					2						1							
Chemistry Lab 1	8												3											
Chemistry Lab 2	6												4						1			2000VA /24VDC		
Instrument Room	6										1		1											
HOD Staff Room	8										2						2				1			
Store Room	8																							

OT*- Old Tube SOT* -Small Old Tube FL* - Focus Light CRB* - Conceiled Round Bulb Led Fix* - Led 1/2 Feetx1/2 Feet *FL Light - Fancy Led Light

V.OCF* - Very Old Ceiling Fan OCF* - Old Ceiling Fan NCF* - New Ceiling Fan EX Fan*- Exhaust Fan *S Fan - Stand Fan

Room	OT *	SOT *	Fancy CFL 60W	100 WFL*	CRB * 9W	LED Tube	LED Fix*	CFL	*FL Light	V.OCF *	OCF *	NCF *	Wall Fan	Ex Fan*	*S. Fan	Projector	System	Printer scanner	Fridge	Freezer	Xerox	UPS Capacity	TV	A/C
Research Lab	8													4										
Research Lab 2	4										1			1			1							
Chemistry Research Lab	6												1	2										
Chemistry Research Room	5												2											
Chemistry Lab 3	12												5	3 Faulty										
Chemistry Lab 4	12										6		3	3 Faulty										
Chemistry Lab 5	16										6			3					1			2000VA /24VDC		
Chemistry Lab 6	7										4													
Chemistry Lab 7	10										6								1			2000VA /24VDC		
English Staff Room	10										2													
Hindi Department		3											1				1	1						
NSS Room											1													
Food Science HOD Room													5	4			2					5000VA /72VDC		
Food Science Lab	8		6				2*				4													
Gym						25							10											
Auditorium	28		7	2			12+2 *			2			3											
Platinum Jubilee Hall	50		23		82								5											4
Yard Light						12																		

OT*- Old Tube SOT* -Small Old Tube FL* - Focus Light CRB* - Conceiled Round Bulb Led Fix* - Led 1/2 Feetx1/2 Feet *FL Light - Fancy Led Light
V.OCF* - Very Old Ceiling Fan OCF* - Old Ceiling Fan NCF* - New Ceiling Fan EX Fan*- Exhaust Fan *S Fan - Stand Fan

8.4 LIGHTING

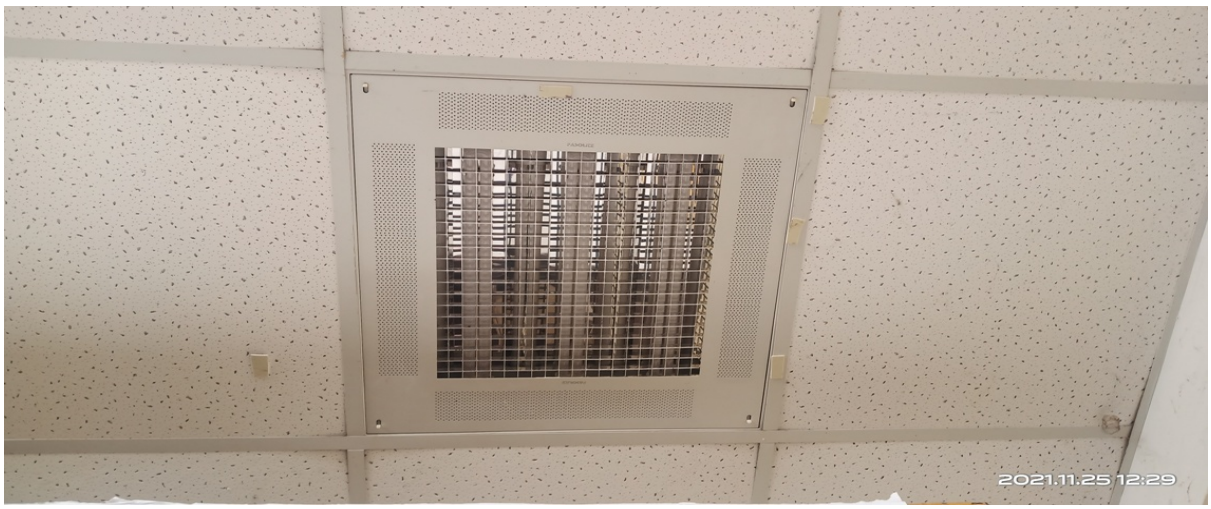
Light emitting Diodes Popularly known as LEDS are most efficient lighting systems. They produce highest lumens per watt of energy consumed compared to florescent tubes, CFLS, metal halide and mercury sodium vapour lamps. It has better colour rendering index and give cool white light for regular use. Luminous efficacy will be the range of 100 to 120 lumens per watt. Apart from above it doesn't has mercury content as in case of florescent lamps. Other added advantages are high input power factor and low heat dissipation. This low heat dissipation will also help in reducing heat load on air conditioners. Bureau of energy efficiency has made use of LED lights as compulsory measure in its Energy conservation building code.

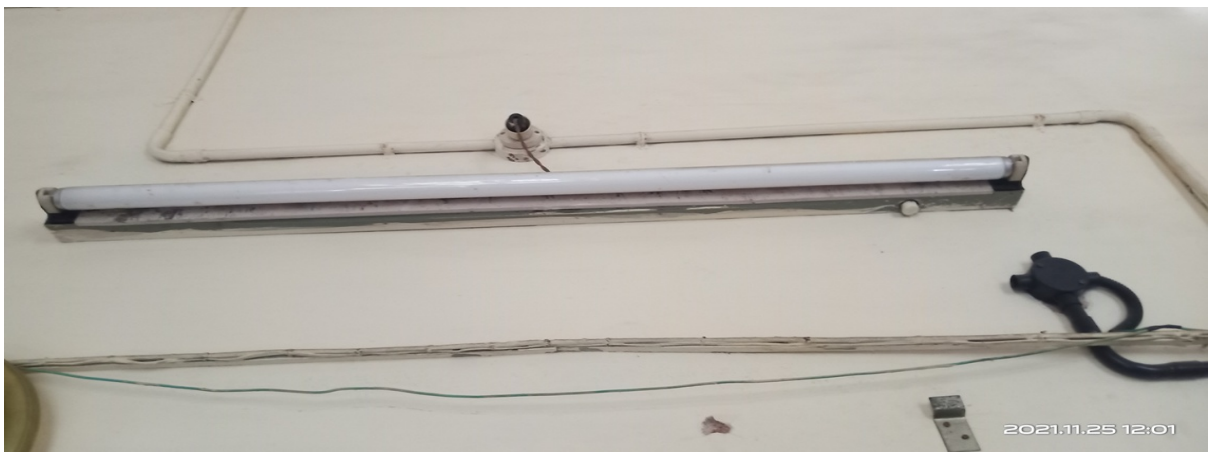
Institution has very less number of LED lights as discussed in connected load chapter LED constitute less than 5% of other types of loads. We recommend to replace all luminaries to LED, in phased manner. Sample calculation along with pay back on investment along with other advantages is given below.

	Proposal: Changing old tubes to LED tubes	VALUE	remark
A	Present power (Watts)	40	average watts
B	proposed equipment power (watts)	20	watts
C	savings in power per equipment (watts)	20	watts
D	Quantity (nos)	1242	Nos
E	Hour of use per annum (per day X 300 days)	1500	5 hours per day 300days
F	savings KWH per annum (C X D X E)/1000	37260	units
G	cost savings @ rs 7.50/unit (F X 7.50)	279450	Rs per annum (incl tax)
H	Investment per equipment	350	Rs (approximate)
I	Total invest (H X D)	434700	Rs (approximate)
J	Return on investment (ROI) D 14/D11	1.56	years
K	Co2 savings (F x 1.20 kgs) D9*1.2	44712	kgs (based on CEA verl4.O 2018)

Other advantages
Reduction in mercury waste 3 to 5 mg from each tube /CFL
easy to handle after end of life
improved power factor (PF)
Recommendation:
To replace all lights to LED in phased way
Tubes which are in regular use can be replaced on priority
LED lights have about 50000 hours life

Note:
yard has 100w 2nos focus lamp which can be converted to LED of 50w
CFL fittings are used in auditorium & other places.
CFL can be replaced to LED, only when present luminary burns out
Pay back period varies depending on actual purchase cost, usage, buy back,tax etc





8.5 FANS

Introduction : Most of the fans used in building are ceiling fans with 1200mm sweep. How ever fans can be of different sizes. Based on blade size of fan BEE has fixed air delivery and power consumption, which is termed as service value .

Sr No	Fan Blade Size(mm)	Minimum Air Delivery (m^3/minute)	Minimum Service Value (m^3/minute/Watt)
1	900	130	3.1
2	1050	150	3.1
3	1200	210	4.0
4	1400	245	4.1
5	1500	270	4.3

New BEE Star Rating Table

Star rating plan table based on the fan blade size is divided into two parts:

1. For sweep size<1200 i.e., for blade sweep of 900 mm and 1050 mm following would be the star rating plan:

Star Rating	Service Value
1 star	≥ 3.1 to < 3.6
2 star	≥ 3.6 to < 4.1
3 star	≥ 4.1 to < 4.6
4 star	≥ 4.6 to < 5.1
5 star	≥ 5.1

2. For sweep size ≥ 1200 mm i.e., for blade sweep of 1200 mm, 1400 mm and 1500 mm the star rating plan would be as shown in the table below. Only the 1 star rated value is different for three different sweep sizes; rest others are same:

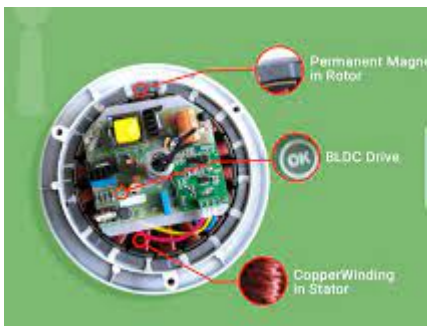
Star Rating	Service Value
1 star	≥ 4.0 to < 4.5 for 1200 mm ≥ 4.1 to < 4.5 for 1400 mm ≥ 4.3 to < 4.5 for 1500 mm
2 star	≥ 4.5 to < 5.0
3 star	≥ 5.0 to < 5.
4 star	≥ 5.5 to < 6.0
5 star	≥ 6.0

As evident from the above table, for the fans with the blade sweep of 1200 mm and above (that's where the majority of ceiling fans lies) to achieve a 5-star rating, it would require a *service value* of minimum 6.0. This is difficult for the fans running on an induction motor. We reckon that newer 5-star rated models would mostly be powered by BLDC motors. And this is good news because BLDC motor is much more energy-efficient and makes it possible for added functionality like wireless control (remote control). You can read how BLDC fan can actually help you to reduce your electricity bills by up to 65% .

	proposal: replacing very old & old ceiling fan to BLDC fan		remark
A	Present power (Watts)	80	average
B	proposed equiment power (watts)	30	BLDC advance technology
C	savings in power per equipment	50	
D	Quantity (nos)	393	17 very old + 376 old
E	Hour of use per annum (perday X 300 days)	1500	3 hours per day 300days
F	savings KWH per annum (C X D X E)/1000	29475	units
G	cost savings @ rs 7.50/unit (F X 7.50)	221062.5	Rs per annum (incl tax)
H	Investment per equipment	2500	Rs (aproximate)
I	Total invest (H X D)	982500	Rs (aproximate)
J	Return on investment (ROI) I/G	4.44	years
K	Co2 savings (F x 1.20 kgs) F X1.2	35370	kgs (based on CEA verl4.O 2018)
Other advantages			
Low noise level, improved PF			

recommendation:
Replace stage by stage . Considering usage level & preset fan condition
Very old fans can be replaced on priority
Note: these fans have remote control, it may be difficult to manage in class rooms
Pay back period varies depending on actual purchase cost, usage, buy back,tax etc

BLDC ceiling fan is one type of ceiling fan which consumes lower electricity compare to normal induction fan. It's also called energy saving fan or brushless dc fan. The full form of BLDC is **Bush Less Direct current**. With the use of BLDC motor in ceiling fan we can save 50% electricity in the ceiling fan. These fans will run & controlled by electronic circuitry. IR based remote controls will be used instead of present conventional fan regulators to control the speed



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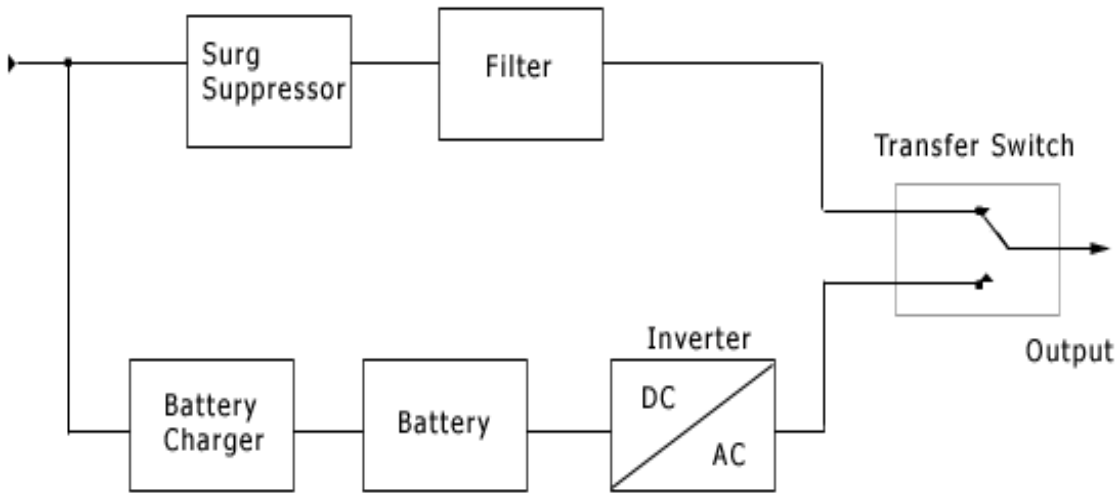
8.6 UPS

Introduction: Uninterrupted Power Supply systems are integral part of any building. It may be used for emergency lighting or for computer and related systems. There are two major types of UPS. One is off line UPS and another is online UPS. Offline UPS takes power from mains when there is regular power supply and draws power from battery when regular power supply fails. Online UPS on other hand works on continuous double conversion. In simple words there is continuous conversion of Dc (battery) power to Ac (regular power) and Ac power to DC. Hence Online UPS consume more energy than off line. However for more sophisticated equipments online UPS gives more stable power.

OFF LINE UPS



ONLINE UPS

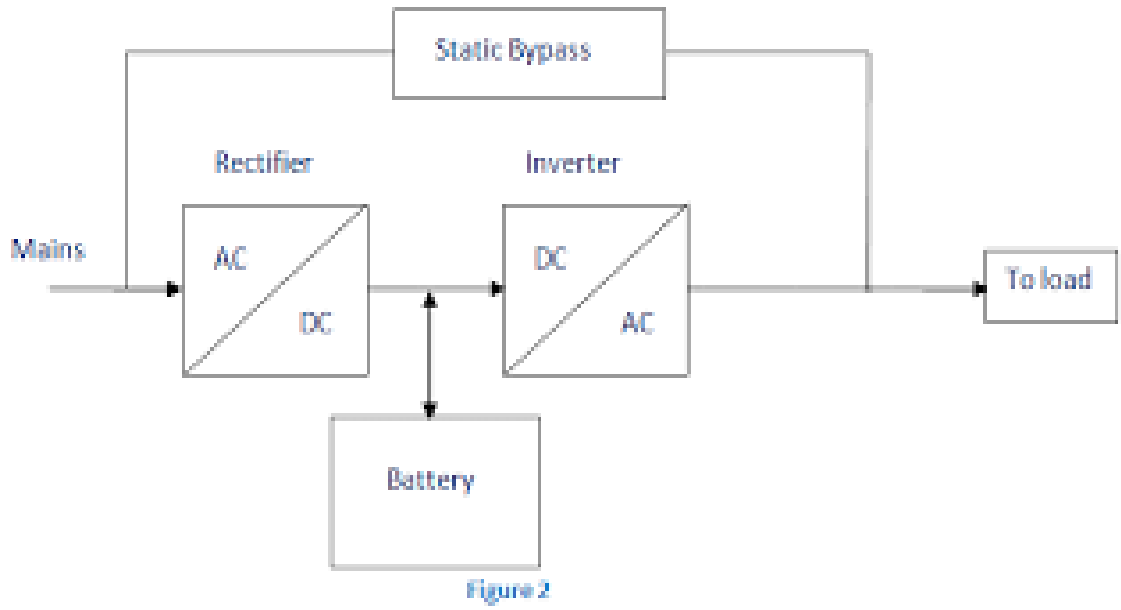


Figure 2

Location	UPS Make	Nos. of Battery	Types of Batteries	Capacity (KVA)	VDC	AH	UPS TECH	Remark
Principal Auto & Chamber	Luminous	1	Tubular	1.05	12	100	Offline	
Ladies Room	Luminous	15	Tubular	10	180	100	Online	
Language Lab	Procom	10	Tubular	5	120	100	Online	
Examination Section	Procom	10	Tubular	5	120	100	Online	
Staff Room	Luminous	6	SMF	5.2	72	100	Offline	
Computer Science CS/1	TPC Sine Wave	4	Tubular	5	48	100	Offline	
Computer Science CS/2	Procom	6	Tubular	5	72	100	Online	
Bio Chemistry Lab 2	Procom	6	Tubular	5	72	100	Online	
Biotec Lab 1	Procom	4	Tubular	3	48	100	Offline	
Molecular Biology Lab 1	Genesis	1	Tubular	1	12	100	Online	HFOL
Molecular Biology Lab 2	Genesis (Online)	4	SMF	2	48	100	Online	HFOL
Electronics Lab	Procom	6	Tubular	5	72	100	Online	
Serculture Practical Hall	Procom	4	Tubular	3	48	100	Offline	
Zoology Lab 1	Procom	6	Tubular	5	72	100	Online	
Zoology Practical Hall 2	Procom	4	Tubular	3	48	100	Offline	
Geology Lab 2 UPS - 1	Inteligent	1	Tubular	1	12	100	Offline	Faulty
Geology Lab 2 UPS - 2	Inteligent	1	SMF	1	12	100	Offline	Faulty
Environmental Science	Digital Inverter	2	Tubular	2	24	100	Offline	
Mathematics Lab	Luminous	6	Tubular	5.2	72	100	Offline	
Statistics Laboratory	Procom	6	Tubular	5	72	100	Online	
Physics Lab 3	Procom	6	Tubular	5	72	100	Online	
Chemistry Lab 2	Silicon	2	Tubular	2	24	100	Offline	

Chemistry Lab 5	Silicon	2	Tubular	2	24	100	Offline	
Chemistry Lab 7	Silicon	2	Tubular	2	24	100	Offline	
Food Science HOD Room	Procom	6	Tubular	5	72	100	Online	
Total	**25**	**121**		**93.45**				

UPS	**Nos. of UPS**	**KVA**
Online UPS	12	58
Offline UPS	13	35.45
Approximate Loading 30-40%		

Battery Type	**Weight*Nos. of Batteries**	**Total Weight**
100 AH Tubular	21 KG Each*110	2310 KG
100 AH SMF	32 KG Each*11	352 KG
Total Lead		**2662 KG**

Remark:
All UPS are loaded at 30-40% most of the time.

All the batteries are of higher capacity for longer back up

Online UPS have medium PF of 0.7 to 0.8.

Overall efficiency of online UPS is about 60-75%,.
Recommendations:

1) It is planned to have generator backup for the new building. Battery capacity can be reduced after generator back up is provided. This will reduce cost & lead waste generation.

2) UPS front switch can be switched off during Sundays and night hours to reduce no load loss.

3) Battery charging current during above non working time can be reduced by use of SMPS charger. This will enhance battery life and reduce risk of UPS fail in night time.

4) Offline UPS with static changeover, IGBT design is more energy efficient. This will reach the need of many appliances of less than 5 KVA capacity.

5) Energy saving by output off in night time (online UPS only)

No load loss of inverter section 100w x 12 nos	= 1200watts
Considering 16 hours per day X 365 days Of no load running	=1.2kwx 16 x365 =7008 units per annum
Investment	nil
Pay back period	immediate
Cost savings @ 7.50 per unit	7008 X 7.5 = 52560/- Rs
Co2 saved at 1.2kg/unit	8410 kgs per annum

6) Energy savings by using SMPS charger in night time:

Power savings in online UPS by using SMPS Charger	50w x 12no s= 600w
Energy savings 6 hours per day X 365 days By SMPS charger	= 0.6 kw x 16 x 365= 3504 units per annum
Cost savings @ 7.5 rs per unit x 3504 units	26280/- per annum
Cost of SMPS charger rs 5000/- X 12nos	60,000/- Rs
Pay back period	60000/26280 = 2.2 years
Co2 saved @1,2 kgs per unit	31526 kgs pr annum
Other advantages	Enhance in battery life Protection to UPS in night time Improved power factor

8.7 Computers and Accessories

With increase in IT utilization in education system and e learning resulted in more such connected load. The other impact include increase in UPS capacity, battery capacity and e waste generation.
The accessories include computers, projector, printer with scanner and multi functional printer. The total number of accessories and its wattage details are as follows:

Accessories	Total Qty	Capacity in Watts
Computer	183	200-300
Projector	30	500-750
Printer with scanner	39	750-1000
Multi-functional printer(Copier)	5	1200-2000
Total	257	-

Remarks: Printers and scanners can be turned off when not in use for a long time. This can save the energy.

Recommendation:

1) It is recommended to replace the old monitors and use the new LCD/LED monitors which can save energy.
2) Re use of entire system or spares will reduce E waste to larger extent.
3) Scarp computers to be handed over to authorized e waste recycler only.

8.8 Pumps

Pumps capacity depends on flow and head. Pumps can work more efficiently if it works at a particular point called “Best Efficiency Point”(BEP). In general pump overall efficiency varies between 50 to 70%. BEE gives star rating for the pumps to indicate energy efficiency level. Use of low resistance pipes, reduction of bends will reduce load on pump. Water conservation and pump automations are other simpler way to conserve energy.

There are three pumps in the campus but 2 pumps are in regular use for kaveri water and 1 pump is used occasionally for bore well water.

PUMP EVALUATION DATA & READINGS
DATE & TIME – 01/02/2022 & 12:20PM
LOCATION – Near Botany

CAPACITY	3 HP or 5hp
TYPE	SUBMERGED
MAKE/ MODEL	-
YEARS OF USE	
STAGE(SUB PUMP)	
REPAIRS/REWOUND	-
WATER FLOW FROM/TO	GLR to Old Building
SUCTION HEAD	0
DELIVERY HEIGHT	60 - 70 Feet
LENGHT OF PIPE	60 - 70 Feet
TYPE OF PIPE	PVC
DIA OF PIPE	4”
USAGE PER DAY	1 Hour 30 Minutes Per Day
CURRENT -R	6.35
CURRENT - Y	6.53
CURRENT -B	6.27
PF	0.8
VOLTAGE- R	239.3
VOLTAGE- Y	240
VOLTAGE- B	245

VOLTAGE- RY	419
VOLTAGE- YB	421
VOLTAGE- BR	415
WATER TDS	151

Power in put = 3782 kw

PUMP EVALUATION DATA & READINGS FORMAT

DATE & TIME – 01/02/2022 & 11:20AM

LOCATION – Near Canteen

CAPACITY	5 HP
TYPE	SUBMERGED
MAKE/ MODEL	-
YEARS OF USE	
STAGE(SUB PUMP)	
REPAIRS/REWOUND	-
WATER FLOW FROM/TO	GLR to New Building Tank
SUCTION HEAD	0
DELIVERY HEIGHT	50 - 60 Feet
LENGHT OF PIPE	50 – 60 Feet
TYPE OF PIPE	PVC
DIA OF PIPE	4”
USAGE PER DAY	1 Hour 30 Minutes Per Day
CURRENT -R	8.21
CURRENT - Y	8.66
CURRENT -B	8.37
PF	0.78
VOLTAGE- R	240.3
VOLTAGE- Y	243.5
VOLTAGE- B	244.1
VOLTAGE- RY	425
VOLTAGE- YB	427

VOLTAGE- BR	423
WATER TDS	151

Power in put =4328kw

Remarks:

1) Present pumps are working with the specified power limit. Current & power factors are within limit and balanced in all three phases.

2) But records related to capacity of pump, make, model, date of installation were not available to access exact efficiency level.

Recommendation::

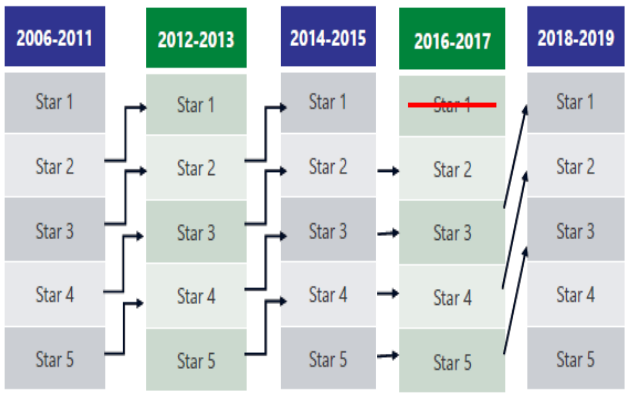
1) Pumps can be automated with auto on-off or timer control or indicative buzzer can be fixed.

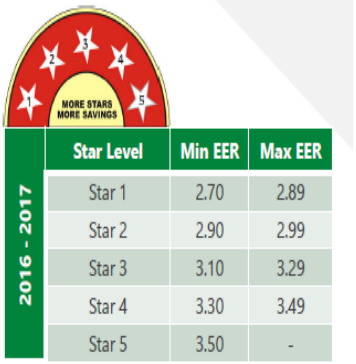
2) Always recommended to buy five star rated pump

3) Head & flow has to matched for optimum efficiency level

8.9 Air Conditioners

Introduction: in any building, air conditioners are used for comfort purpose along with dust free and controlled environment in computer server rooms or labs. Majority of air conditioners will be split air conditioners of direct expansion type. Large buildings with central air conditioning will have duct based central units. BEE has set standards for split air conditioner energy efficiency levels. Based on energy efficiency Star rating will be given. These standards will vary in accordance with technological advancement. Example is given below





Star Level	Min EER	Max EER
Star 1	2.70	2.89
Star 2	2.90	2.99
Star 3	3.10	3.29
Star 4	3.30	3.49
Star 5	3.50	-

Along with equipment efficiency, usage pattern, reduction of heat gain ,set temperature & maintenance will play important role in energy conservation. BEE has recommended to set temperature to above 24 deg C for comfort use.

Different types of refrigerants are used in air conditioners. Among them R11 and R22 have more global worming potential and are out dated now. R410 is currently used refrigerant. Replacing R11 and R22 by R410 is not technically feasible.

There are totally 8 Split acs & one central AC at auditorium. The details are given below:

Location	Botany Staffroom
Make	Volts
Star Rating	3 Star (EER - 3.51)
Capacity	1 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1002 W
Cooling Capacity	3520 W
Year of Manufacture	2018

Location	Statistics Lab
Make	LG
Star Rating	2 Star (EER - 3.0)
Capacity	1.5 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1460 W
Cooling Capacity	4600 W
Year of Manufacture	2014

Location	Maths Lab
Make	LG
Star Rating	2 Star (EER - 3.0)
Capacity	1.5 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1460 W
Cooling Capacity	4600 W
Year of Manufacture	2014

Location	Maths Lab
Make	LG
Star Rating	2 Star (EER - 3.0)
Capacity	1.5 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1460 W
Cooling Capacity	4600 W
Year of Manufacture	2014

Location	Statistics Lab
Make	LG
Star Rating	2 Star (EER - 3.0)
Capacity	1.5 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1460 W
Cooling Capacity	4600 W
Year of Manufacture	2014

Location	Statistics Lab
Make	LG
Star Rating	2 Star (EER - 3.0)
Capacity	1.5 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1460 W
Cooling Capacity	4600 W
Year of Manufacture	2014

Location	Board Room
Make	LG
Star Rating	2 Star (EER - 3.0)
Capacity	1.5 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1460 W
Cooling Capacity	4600 W
Year of Manufacture	2014

Location	Board Room
Make	LG
Star Rating	2 Star (EER - 3.0)
Capacity	1.5 TR
Type of Compressor	Non-Inverter
Refrigerant	R22
Input Power	1460 W
Cooling Capacity	4600 W
Year of Manufacture	2014

Remark:

- All air conditioners are in working condition
- Usage is very much limited
- Present Acs are 2 & 3 star rated
- Refrigerants used in air conditioners are R1 & R22
- Recommendations:
- Presently used Acs are having EER of 3 to 3.51 . Air Conditioners with 5 star ratings have EER of 5.0
- ACs with inverter technology will save energy & there will not be any starting surge
- Present ACs use more environmental friendly Refrigerant R410a , than present R11 or R22

We suggest to buy 5 star rated Air Conditioners with inverter technology and R410 a refrigerant in future
Recommended to use occupancy sensors , wherever applicable.
BEE recommends st temperature for comfort use as min 24 deg C.
Every degree increase in set temperature will save about 6% of energy

8.10 Refrigerator

There are 20 Refrigerators and 3 Freezers for lab usage and other purpose in the college. The energy consumption depends on doors of a refrigerator, such as single door and double door. Because single door fridge doesn't de-frost the ice but double door fridge automatically de-frosts the Ice. So, double door fridge consumes more energy. It also depends on the size of a refrigerator. Refrigerators details which are used in the campus are as follows:

Location	Principal Auto & Chamber
Make	Godrej
Star rating	5 star
Model/Year	GDE 19 B1/2010
Units Per Year	262 Units
Storage Volume	178 Ltrs.

Location	Micro Biology 1
Make	Samsung
Star rating	3 Star
Model/Year	
Units Per Year	265 Units
Storage Volume	320 Ltrs.

Location	Micro Biology 2
Make	Samsung
Star rating	4 Star
Model/Year	RT23/2009
Units Per Year	433 Units
Storage Volume	208 Ltrs.

Location	Micro Biology 2
Make	Samsung
Star rating	No star label
Model/Year	RT45LSPN1/2011
Units Per Year	325 Units
Storage Volume	359 Ltrs.

Location	Bio Chemistry Lab 2
Make	Samsung
Star rating	3 Star
Model/Year	RT37K3993SL/HL/2016
Units Per Year	265 Units
Storage Volume	321 Ltrs.

Location	Bio Tech Lab 1
Make	LG
Star rating	5 Star
Model/Year	GL-338VA5/2010
Units Per Year	402 Units
Storage Volume	290 Ltrs.

Location	Bio tech Lab 2
Make	LG
Star rating	4 Star
Model/Year	GL-325/2008
Units Per Year	490 Units
Storage Volume	274 Ltrs.

Location	Molecular Biology Lab 1
Make	Samsung
Star rating	2 Star
Model/Year	N/A
Units Per Year	390 Units
Storage Volume	400 Ltrs.

Location	Sericulture Practical Hall
Make	Any
Star rating	No star label
Model/Year	
Units Per Year	70 Units

Location	Molecular Biology Lab 2
Make	Samsung
Star rating	4 Star
Model/Year	RT34/2008
Units Per Year	494 Units

Storage Volume	50 Ltrs.	Storage Vol.	319 Ltrs.
Location	Zoology	Location	Molecular Biology Lab 2
Make	Samsung	Make	Samsung
Star rating	4 Star	Star rating	No star label
Model/Year	RR1914ASBSC/TL/2013	Model/Year	
Units Per Year	310 Units	Units Per Year	300 Units
Storage Volume	183 Ltrs.	Storage Vol.	300 Ltrs.
Location	Ashadevi Room	Location	Practical Hall 1
Make	Videocon	Make	Godrej
Star rating	4 Star	Star rating	No star label
Model/Year	VRE184/2011	Model/Year	
Units Per Year	114 Units	Units Per Year	100 Units
Storage Volume	166 Ltrs.	Storage Vol	100 Ltrs.
Location	BSE 1st Year Lab	Location	Sericulture Room 1
Make	Godrej	Make	LG
Star rating	No star label	Star rating	5 Star
Model/Year		Model/Year	GL-195NP5/2010
Units Per Year	100 Units	Units Per Year	244 Units
Storage Volume	100 Ltrs.	Storage Vol.	175 Ltrs.
Location	Chemistry Lab 2	Location	Sericulture Practical Hall
Make	LG	Make	Samsung
Star rating	4 Star	Star rating	2 Star
Model/Year	GL-D201AMHL/2016	Model/Year	RT26H3000SC/TL/2014
Units Per Year	245 Units	Units Per Year	383 Units
Storage Volume	180 Ltrs.	Storage Vol	228 Ltrs.
		Location	Molecular Biology Lab 2
Location	Chemistry Lab 5	Make	LG
Make	Godrej	Star rating	4 Star
Star rating	3 Star	Model/Year	GL-244GP4/2008
Model/Year	GFE25AC/2009	Units /Year	450 Units
Units Per Year	533 Units	Storage Vol	203 Ltrs.
Storage Volume	199 Ltrs.		

Remarks: There are different types of star rating labels for different refrigerators. The following are the total number of refrigerators with different types of ratings:

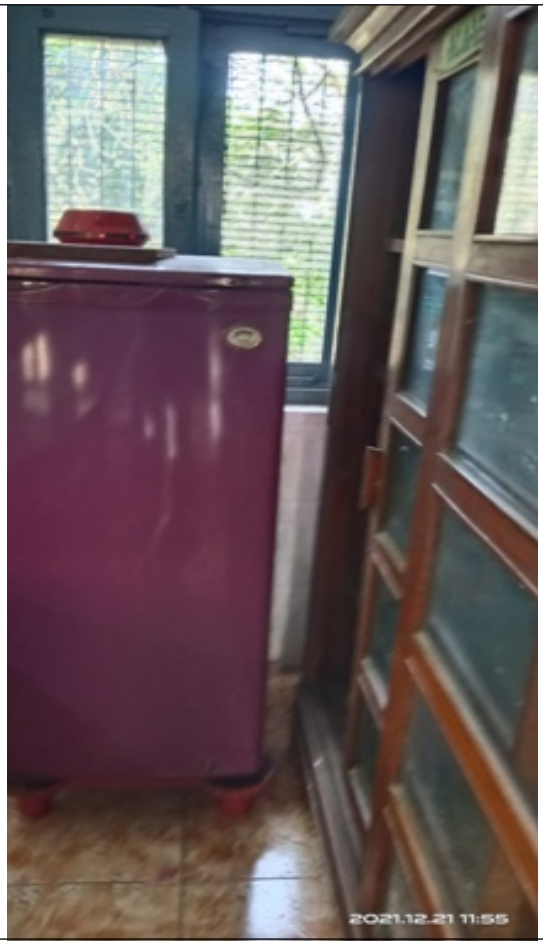
Rating	Qty
2 Star	2
3 Star	3
4 Star	7
5 Star	3
No star	5

The total energy consumption by these refrigerators is 6175W.

Recommendation:

It is recommended to buy 5 star rated refrigerators in future.

Presently used old refrigerators (without any star label) can be replaced , only if it fails to function.



8.11 AUTOMATION

Automation describes a wide range of technologies that reduce human intervention in processes. Human intervention is reduced by predetermining decision criteria, sub process relationships, and related actions — and embodying those predeterminations in machines.

Automation,[1] includes the use of various equipment and control systems such as machinery, processes and other applications with reduced human intervention.

Automation covers applications ranging from a household thermostat controlling , to a large industrial control system with tens of thousands of input measurements and output control signals. Automation has also found space in all the b sector. In control complexity, it can range from simple on-off control to multi-variable high-level algorithms.

Upcoming trends includes IOT (internet of things) AI (artificial intelligence) & ML (machine learning)

Advantages

1)Accuracy 2)Reduced human error

3) Energy savings 4)Enhanced life of equipments

Based on study we conducted at your institute, we recommend following automation systems.

1)Energy monitoring & recording (EMS) at two locations: One at new building panel board & another at old building panel board). This will record and store all power parameters. Institution doesn't has separate meter at present and paying energy charges to university. Using this data voltage , load and energy consumption can be recorded periodically.

2)Pump control (total automation or timer or buzzer indication); Presently water pump is witched on & off manually. Automatic control will reduce human interface and avoid dry and over flow condition. An hour meter can be fixed to records hours of pump usage. This hour meter reading will also help to evaluate energy consumption and water usage OR Timer control to switch off pumps can be adopted. This will reduce chances of forgetting switching off the pump. However automatic 'on-off' will give complete solution

3)Auto day & night switch for yard lighting or timer based control: Yard lights are switche on & off manually at present. There i every chance that these lights are switchd on early than needed or switched off late. To avoid such condition automatic day night switch can be installed. These switches has to be installed to street light circuit or to any high power lights directly.

4)Occupancy based exhaust fan control in rest rooms & labs : there are chances that exhaust fans run unnecessarily. Occupancy sensors will switch off fans after pre fixed time, when there is no occupancy.

5)IR based occupancy control for air conditioners: Air conditioners take heavy power. An .5 ton air conditioner will draw about 7 to 8 amps of current. An Infra red (IR) based occupancy sensor can be fixed to reduce unoccupied usage. But these can be used where air conditioners are used for human comfort , not for any process control or lab purpose. .

8.12 LUX Level

Introduction: Lux is luminous flux in unit area. It is a measure of light. Improper design of lighting system or less opening to natural light will reduce the lux level. National Building code has given standard of lux level for different applications. Class rooms and office rooms needs minimum 200 lux for comfortable working. (One lux is one lumen of light distributed evenly in one sq meter.

In the old building of the campus, there is no sufficient day light as well as old tubes are used and LED lights are not used. So, the lux level is very low. Low lux level will result in fatigue and disorientation and eyes will get strained. Some rooms are having sufficient level of lux in the old building. Lux level should be 200 to 300 .

We have done a sample survey in between October to November where there is no much sun light during those days.

Recommendation: We recommend to replace faulty lights in these rooms by new LED lights .

Old building random survey

Room	**LUX**	Old building- floor
Class Room 1 (Botany dept.)	298	First Floor
Practical Hall 1 (Botany dept.)	153	First Floor
Sericulture Practical Hall (Botany dept.)	90	First Floor
Zoology Lab 1	147	First Floor
Geology Lab	58	First Floor
Mathematics Lab	132	First Floor
Board Room	88	First Floor
Physics Lab 3	50	Ground Floor back side
Physics Lab 4	103	Ground Floor back side
Chemistry Lab 1	54	Ground Floor back side
Chemistry Lab 2	60	Ground Floor back side
Chemistry Lab 3	200	Ground Floor back side
Chemistry Lab 5	114	Ground Floor back side

New building details:

In the new building is having good day light as well as lights are working. lux level is very good and sufficient on the work plane or benches.

Floor	Room	LUX Level
Ground floor	Molecular Biology Lab	125
	Molecular Biology Staff room	143
	Biotechnology Lab	164
First floor	Bio Chemistry Lab	169
	Micro Biology Lab	120
Second floor	Computer Lab	206
	Computer Lab Staff room	223

Floor	Room	LUX Level
	CB Building	
Ground floor	CB 5	213
	CB 12	219
First floor	BBA	230
	MBA	249

LUX WITHOUT LIGHTS (Natural day light)

RB Building	LUX Level
RB 1	174
RB 3	130

Images taken at various locations

8.13 Water TDS (Hardness)

Introduction: TDS represents total dissolved salts in water. Water will have lots of minerals which are useful for human body. There are calcium and sodium salts also in water which makes water “hard”. Such hardness will cause lots of other problems. These salts will deposit in water pipe lines, electric heaters, and solar water heaters. Water hardness is measured by PPM (Parts Per Million). Any water with less than 150 ppm will not cause any problem and more than 250 PPM causes many problems.

Institution’s main source of water is Corporation water (Kaveri). When we have measured TDS by PPM Meter, we found out the PPM is 125 to 150ppm So, water is less hard. College is using RO plant for purifying the water for drinking purpose. After purifying the water, TDS is 10ppm PPM. It can up to 75 PPM. The waste water which comes out after purifying by RO Plant is used for plants and trees.

8.14 Natural Day light and ventilation

In the old building there is less natural day light because of small windows. In the new building, there is a good natural day light because of wide windows. Ventilation is good in both the buildings.

8.15 Electrical Panel boards

Yuvraja college has two blocks , old building & new building. Both have separate electrical panel boards. After examining panel boards we found following discrepancies. These are related to safety ,control and monitoring and hence to be treated as priority matter.

1) We found live and dead rats in new building panel board. It is required to secure both panel board by entry of any creature, including lizard. Else it may lead to cable damage or even short circuit issue.
2) There is SLD (single line diagram) of electrical lay out. It required to trace circuit, in event of fault
3) There is no labelling on control switch gear. This is required to control , isolate or reset circuit easily in case of any issue on load side
4) Even though power factor of entire campus is maintained excellent at “near unity”, panel board at new building is over compensated. This has resulted in leading power factor from 0.13 to 0.5. This is not recommended. Central power factor correction Capacitor bank can be redesigned this avoiding over compensation at any panel board.
5) Power factor at panel board of old building is measured between 0.7 to 0.8 lag, This is normal considering load type at present. This lag is compensated and over all power factor at metering is near unity.
6) Panel board has analog meters . But these are not working. Better to replace with digital meter with multifunction facility even to record energy consumption
7) Panel at old building doesn’t have any meters to read parameters. It is recommended to fix CTs and multi function digital meters to read power & energy.
8) At present there is no facility to measure actual energy consumption of Yuvaraja college. Fixing of multi function meters as mentioned above will help to monitor all power parameters along with energy consumption. So that institution can pay on actua;l nergy consumption and can evaluate its performance.
9) EMS –Energy Monitoring system , is another advanced soft ware tool, which takes readings from above meters. This can be analysed and proper action can b taken. This will be learning opportunity for interested electronics & computer students.

Image of panel boards	Image of rats in panel board
	

9. Renewable energy

9.1 Introduction to Renewable energy:

Recent years India witnessed exponential growth in renewable energy. Among all renewable energy sources, such as wind, solar, bio mass, waste to energy, etc, solar energy is easily harvestable and scalable. Solar energy utilisation can be stared with very low power from 50w and scale up to megawatts.

Even with implementation of small roof top systems to large solar parks, India is still depending on fossil fuel based power plants. Fortunately ours is being tropical country, there is ample opportunity to utilise solar energy.

In this chapter we see present renewable energy utilisation and opportunity to implement more solar energy in the campus. We see campus is not utilising solar in any considerable manner. Hence we can discuss different opportunity to utilise solar power.

Ways to utilise solar PV (photo voltaic) power are as below:

1)Solar thermal : since institution does not require hot water , there is n requirement of solar water heater

2)Solar street light (solar DC power system); Institution has six solar street lights. Its present condition & recommendation is discussed in next chapter

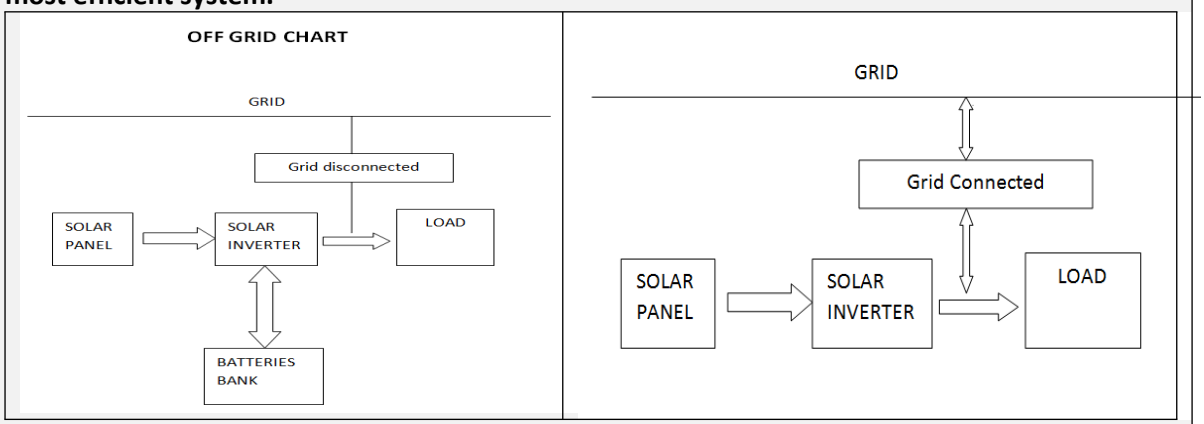
3)Solar off grid system : presently there is no solar off grid system. Implementation option given in next chapter

4)solar on grid (grid tie) system: opportunity and limitations are discussed in next chapter.

Solar off grid and on grid (grid tie) system

Solar off grid system: Here energy produced from solar panels are stored in batteries. It will be converted to useful regular AC using inverters. Energy produced from solar has to used for own purpose. Excess generation (if any) will be wasted. Hence capacity utilisation is less, initial investment is high and running cost also more due to battery utilisation. Still this system is in practice , where load requirement is less and on grid system is not possible

Solar on grid system : Here solar power produced is connected to grid supply and load. This system does not require batteries. In case of excess power is generated by solar, it will be exported to grid. Similarly any short production will be compensated by grid supply. This is most efficient system.



9.2 Renewable energy usage at present and recommendations

(a)Solar street light system:

Institution has six solar streetlights. Unfortunately none of them are in working condition.

Usually solar panels will have life of 20 years. There more chance of putting them to use again. But lights , batteries and control circuit to be replaced.

Recommendation:

1) Check solar panel condition of all street light system (See chapter 9.3)
2) Recondition depending on solar panel working and efficiency condition
3) One of the solar street light is installed in the shade of trees , which needs to be re located ,if brought to use.
4) Advanced integrated street lights with Li ion batteries can be used in future

Advantages:

1) Reconditioning of solar lights will cost less than 50% of new street lights
2) They also serve as emergency lights during power cut
3) The basic work can also be done as projects by students.



(b)Solar off grid system:

As explained in earlier chapter, this is stand alone system. Solar energy produced ahs to be utilised for self only and excess energy cannot be exported. Most suitable for capacities up to 5kwp. However can be increased depending on site condition. This system requires battery bank, due to this limitation overall project will increase, payback period will be more, in addition there is always a risk of battery cost and lead waste generation in every 3 to 5 years.

These types of systems are recommended, where on grid solar implementation is not possible and power utilisation is mostly in day time. This will reduce battery sizing, depth of discharge and enhancing battery life. These kinds of systems are also recommended where battery and Ups sytems are already in use and maintenance of such system is mandatory.

Institution is using UPS in various location for its computer and lab use. (list is provided in earlier chapter) This gives more opportunity to change on convert existing system to solar based UPS system.

Advantages:

1) Institution uses labs & computers in day time
2) There is no need to change in internal wiring
3) There will not be any additional lead waste generation or cost addition of batteries by solar
4) Present system and /or batteries can be utilised if feasible, else has to be shifted where there is need.
5) Institution is mandatorily maintaining UPS & batteries, only solar and related infrastructure cost will be additional expense.
6) This is best alternative option to use solar , as on grid solar implementation has limitations.

Limitations:

1) Proposed Solar inverter (PCU) specification has to meet present load usage pattern
2) Solar to mains change over and vice versa not to interrupt process
3) Batteries will be subjected to more cycle of operation. Hence solar rated batteries has to be used
4) There has to be minimum 50 to 60 % of average loading, else excess power will be wasted
5) Panels & batteries need to be maintained periodically.

Pay back calculation for typical 5kwp off grid system

Present systems 5kva on line ups with 10 Nos of batteries	Rs.1,50,000/-
Additional cost for going to solar based on line ups system 1)solar panels 5kwp 2)structure 3)solar PCU (instead of regular online UPS) 4)solar grade batteries 10 nos instead of regular batteries	Rs.2,00,000/-
Energy saved based on 75% utilisation of generated power and CUF of solar at 15%	3 units/kwp/day x 300days x 5kwp= 4500 units per annum
Cost saved @ Rs 9/- per kwh Considering future escalation	4500 x 9 = 40,500/- per annum
Recovery of additional cost incurred for adding solar	=2,00,000 / 40500 =4.9 years
Carbon saved @1.2 kgs per kwh	=4500 units X 1.2 kgs per kwh =5400 kgs per annum

Note:

1)Above is neither commercial offer or estimate for calling tender. It is over view of project

2)Basic Cost per kw may decrease or increase depending on quantity

3) additional cost such as tax, excise duty, etc may change cost estimation

Recommendation:

Considering all above factors , we recommend to install either one or two solar off grid systems.

(c)Solar on grid system

Draft Proposal for Solar Roof Top SPVRT system on "net metering" basis for total campus (including Yuvaraja, Maharaja college building & VC quarters)			
A	Contract demand	250	KVA
B	Energy consumption (2019-2020)	3,00,000	UNITS
C	Provision for addition in coming years 25%	105000	UNITS
D	Total consumption expected	405000	UNITS
E	Capacity of solar plant for "Net Zero Energy" campus Considering 4kwh/day/kwp average	277	KWP
F	As per regulation maximum solar capacity allowed is limited to contract demand (sanctioned load) at 0.9 PF	225	KW
G	Energy generated by 225kwp solar plant	328500	UNITS
H	Space required @ 6 sqmtr per kwp (6 x225)	1350	sqmtr
I	Project cost at rs 40,000/- Rs per kwp (based Bench mark cost)	90,00,000	Rs
G	Subsidy not applicable for this category of consumer	0	
H	Pay back period considering Rs 9/- per unit and	3	years
	3,28,500 units of energy for self utilisation		
I	Life of project	25	years
J	Carbon savings @rs 1.2 kgs/unit (based on CEA verl4.O 2018)	394200	kgs
	Note:		
1	Fixed charges will continue		
2	Actual import & export of energy depends on seasonal variation and load		
3	Since there is common metering for three locations (Yuvaraja, Maharaja & VC quarters) installing solar individually is not possible		
4	CHESCOM will consider it as single consumer		
5	Above costing is not commercial offer or estimate to call tender		
6	Costing may vary 10 to 20% depending on cabling condition, taxes, custom duty , etc		

9.3 Present condition of solar street lights

Sl. No.	Location	Condition
1	In front of new building (1)	Panel ok, Battery dead, charge controller faulty, LED light ok Battery box corroding
2	In front of new building(2)	Panel ok, Battery dead, charge controller faulty, LED light ok Battery box corroding
3	Inside park (1)	Panel ok , No battery & charge controller CFL light faulty Light is installed in shade of trees
4	Inside park (2)	Panel ok , Battery 42ah Faulty No charge controller No light (only CFL casing is present) Light is installed in shade of trees
5	Near old building(1)	Panel OK No battery & charge controller LED lights are working Battery box are corroding Lamp post is inclined
6	Near old Building (2)	Panel OK No battery & charge controller LED lights are working Battery box are corroding Lamp post is inclined
	Total 6nos (all are in fault condition)	

Panel condition referrer's min 50% working efficiency

Recommendation:

1) To recondition two numbers. Two in front of new building can be considered on priority
2) Solar panels of other street lights are in better condition. This can be used to academic purpose to educate the students .

10.1 Energy Performance Index

Introduction: Energy performance index (EPI) is total energy consumed in a building over a year divided by total Built up area in kWh/sq m/year and is considered as the simplest and most relevant indicator for qualifying a building as energy efficient or not.

ECBC compares EPI of any building with standard design. BEE has set different bench marks for commercial buildings with air conditioning and without air conditioning for different climatic zones.

Building	Floor area (approx)	No. of floors	Total
New Building	540	3	1620
Old Building	3781.78	2	7563.56
Platinum Jubilee Hall	520.51	1	520.51
		Total	**9704.07**

(All area in Sq.m.)

EPI = Total energy consumption in a year/total area in sq.m.

7000*12/9704

= **8.65** KWH/Year/Sq.m.

Observation:

BEE has not set any bench mark of educational institution. 8.65 EPI is excellent performance considering classrooms and lab usage based on our experience and study.

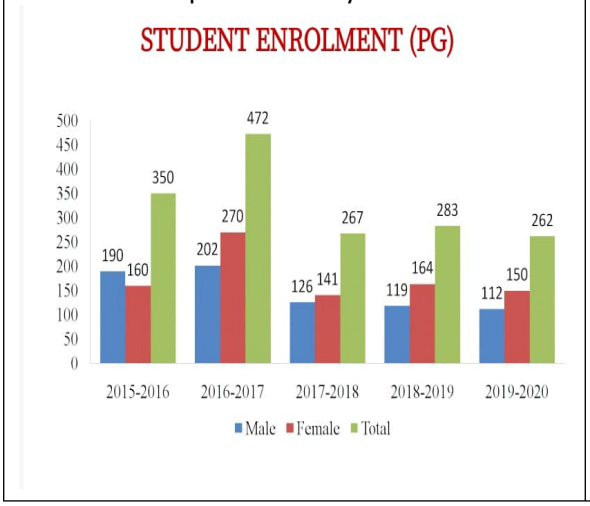
10.2 Per Capita Energy Consumption

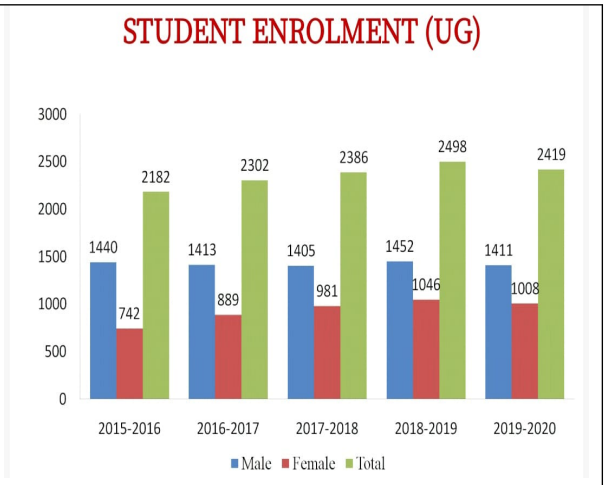
We have calculated energy consumption by each person in the institution. Energy consumption varies depending on type of activity, facility, etc. Since campus has a common meter, based on our calculations, we have already assessed the energy consumption of Yuvaraja College as 7000 units per month. i.e. 84000 units annually.

Total persons using the facility include UG 2419, PG 262, and faculty 238, totally 2919.
Per capita energy consumption - 84000/2919=28.77 units per person per annum.

There is no definite standard for above. But based on basic facilities and lab above value found justified.
However use of renewable energy & encon measures will reduce consumption level by 10-15%

Remarks: We have taken students and staffs count as per the year 2019-2020.





11.Environment Audit

11.1 Introduction:

Environment Audit is a general term that reflects various kinds of evaluations intended to identify environmental compliance and management system, implementation gaps, along with related corrective actions. It is used to determine the types of waste and volume of waste, which can be used for a recycling project or to improve waste minimization plan by avoiding the things which creates more waste. It can create health consciousness and promote environmental awareness, values and ethics. All these can be achieved by creating awareness, best practices and use of technology.

Objectives of Environment Audit: Concern about environmental degradation and realization of values of environment are logical consequences of scholarly research, teaching and learning process. In its pursuit for improving environmental quality and to maintain a pristine environment for the future generations of students, Following objectives to achieve:

1) Establishing a baseline of existing environmental conditions with focus on natural and physical environment.
2) Understanding the current practices of sustainability with regard to the use of water and generation of wastes, etc.
3) Awareness generation among students concerning real issues of environment and its sustainability.
4) Promotion of environmental awareness through participatory auditing process.
5) To create a report that document baseline data of good practices and provide strategies and action plans towards improving environmental quality for future.

In order to keep as much waste material out of the landfill as possible, it's important for each of us to do our part. One of the ways to put that plan into action is through the 3 Rs of waste management — Reduce, Reuse, Recycle. Reduce means to cut back on the amount of trash we generate. Reuse means to find new ways to use things that otherwise would have been thrown out. Recycle means to turn something old and useless (like plastic milk jugs) into something new and useful (like picnic benches, playground equipment and recycling bins	

11.2 Types of Waste Generated

Types and quantum of Waste generation in an organization depends on nature of activity, practice and number of people in the organization.

Following types of waste generation possibilities exists in institution.

Types of Wastes:

1) Dry Waste: Dry waste means dry materials that have been contaminated. It has categorized into

   three types. They are: A) Paper Waste

   B) Dry Leaf Waste

   C) Plastic Waste

2) Wet Waste - Food Waste
3) Biological Hazardous Waste – Sanitary Pads
4) Chemical waste from labs
5) E waste - Electrical & Electronic Equipments
6) Hazardous Waste - Mercury waste by Fluorescent Tubes
7) Hazardous waste - Lead waste by batteries
8) Sewage Waste Water. .

11.3 Sewage Water

The main source of water for the college is from corporation.

Quantum of generation: The quantity of waste water is calculated from the consumption of water for the regular usage except for lawn and gardening. The details are given below:

Reading dated	**Reading**
30-09-2109	**3372000**
30-08-2018	**821000**
Consumption (annum) 18-19	**2541000**
Consumption average per month (ltrs)	**212583**
Present average based on MCC bill (Ltrs)	**286000**
Water Consumption	**Qty in Ltrs.**
Annual Consumption	2551000
Monthly Consumption	286000
Per Day Consumption	9533

As per the above table, sewage waste water is around 9533 ltrs per day.

Present way of disposal: Sewage water is drained to corporation UGD system.

Recommendations:

1) Having Own STP (Sewage Treatment Plant) : As per PCB norms institution needs to have its own STP. But we don't recommend it for only Yuvaraja college building. If it is for entire campus, it will be helpful.

2) Reduce water wastage in taps: Water flow can be controlled using pressure reducing valves. Automatic sensor based tap control or foot operated control can be used in selected locations. (Details given below)
3) Rain water harvesting (Details given below)
4) Bore well recharge pit (Details given below)
5) Awareness Posters & boards near taps : Creatively designed posters and easily visible boards will boards with message to “save water” , “close tap properly”, etc will create awarwness in students
6) Rain Water Harvesting.

Remarks: We have taken 3 bills (each bill in each year 2018, 2019 & 2021) as a sample for calculation of water usage. Sample bills have attached below :

11.3.1 Rain Water Harvesting:

Catchment: Area: 4000. **Sq.m (Derived from Google image)**

(Area= 4000Sq.m approx)			
Sl. No.	**Month**	**Rain fall (mm)**	**Quantity of Rain Water**
			Harvestable (L)
1	January	114.9	459600
2	February	74.6	298400
3	March	80.3	321200
4	April	88.4	353600
5	May	110.7	442800
6	June	184.6	738400
7	July	64.9	259600
8	August	15.7	62800
9	September	1.5	6000
10	October	2.9	11600
11	November	9.8	39200
12	December	70.6	282900
TOTAL		**818.9**	**3275500**

From the above table it is clear that there is ample scope for Rain water harvesting it is also evident that about 37.5lakh liters of water can be harvested every year and can be utilized for domestic and drinking purposes.

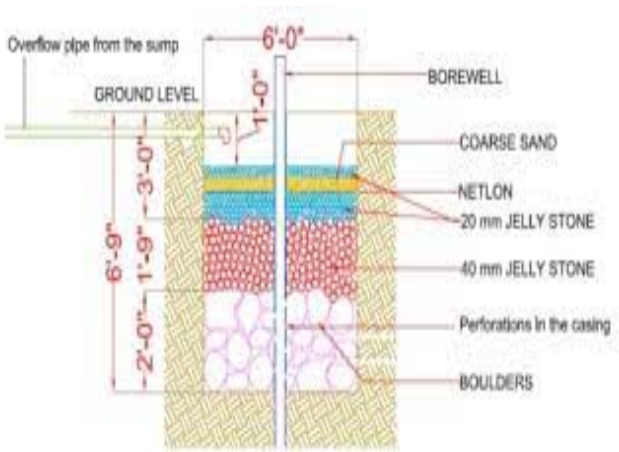
Present scenario: There is already a Good Rain Water harvesting system implemented at the new building. It has two collection tanks. One has one lakh litr capacity and another 50,000 ltr capacity, total collection capacity of 1.5 lakh litres but due to no maintenance it is not functional at the moment.

Recommendations:

1. We recommend the institution to add addition filters and undertake repair works so that the system regains its functionality.
2. Even after repair and other works it is very much required to maintain the rain water harvesting system on regular basis. .

11.3.2 Bore well Recharge Pit

Bore well recharging technically focuses on the use of harvested surface water (obtained via rainfall or nearby water bodies) where runoff water begins to pass through a natural filter made up of large and small stones. Then, there is another layer of sand through which water passes and finally, it perforates in the bore well pipe via a fine mesh which is wrapped around the drilled casing pipe. The fine mesh ensures the removal of big and tiny impurities before the water enters the borewell.



Recommendation: As your institution having 1 borewell and depending on it occasionally, if you create bore well recharge pit, it will be helpful.



Recommendations:

3. We recommend the institution to add addition filters and undertake repair works so that the system regains its functionality.
4. Even after repair and other works it is very much required to maintain the rain water harvesting system on regular basis. .
5.

11.3.3 Water Flow Control at Taps

1)Reducing pressure will reduce water flow from taps. This is simplest and cost effective way to control water wastage. It is recommended to fix such pressure reducing valves at taps of sink to reduce water usage.
2)use of automatic sensor system is another way used in hotels and other offices. Bit this is costly and maintenance is bit difficult in college. Hence it is not recommended at present.
3)Foot operated taps are another way to water wastage. Tap will be open only when it is pressed by foot operated mechanical control . This is another useful technology for covid like situations.

11.3.4 other water conservation measures

RO Water Reuse

Institution has a RO Plant (reverse osmosis) for water purification purpose. After purifying, waste water is being used for plants in the garden.

Water usage from Kukkarahalli Lake

Institution has taken water connection from Kukkarahalli lake for regular supply of water to the plants and trees in the campus by using pump.

Recommendation: There is no recommendation. Because this type of water connection is very helpful for the institution, they can save the money and avoid the corporation water usage.

11.4 Dry Waste – Paper Waste

Paper Waste is generated by the students and staffs while printing the exam papers and others.

Quantum of waste generation: Around 25-30 Kgs of paper waste is generated per day in the college.

Present way of disposal: Paper waste is being collected separately in each department but dumped in the common dustbin with other wastes and handed over to the corporation.

Recommendation:

1) Keep the big and separate dustbin for overall paper waste in the campus and don't mix with other wastes. So that it will help to recycle it and use again.
2) If possible, paper waste can be decomposed and use it.

11.5 Dry Waste - Leaf Waste

Leaf wastes are generated by trees and plants due to season.

Quantum of waste generation: It is estimated that 1-2 cubic mtr. dry leaf wastes are generating inside the campus every day in the particular season.

Present way of disposal: Currently, dry leaf waste is dumping in the common dustbin and giving it to the corporation.

Recommendation:

1) We recommend to use vermi-compost to decompose the dry leaf waste. Because it produces manure and helpful for the plants' growth.
2) Use the separate dustbin for dry leaf waste.

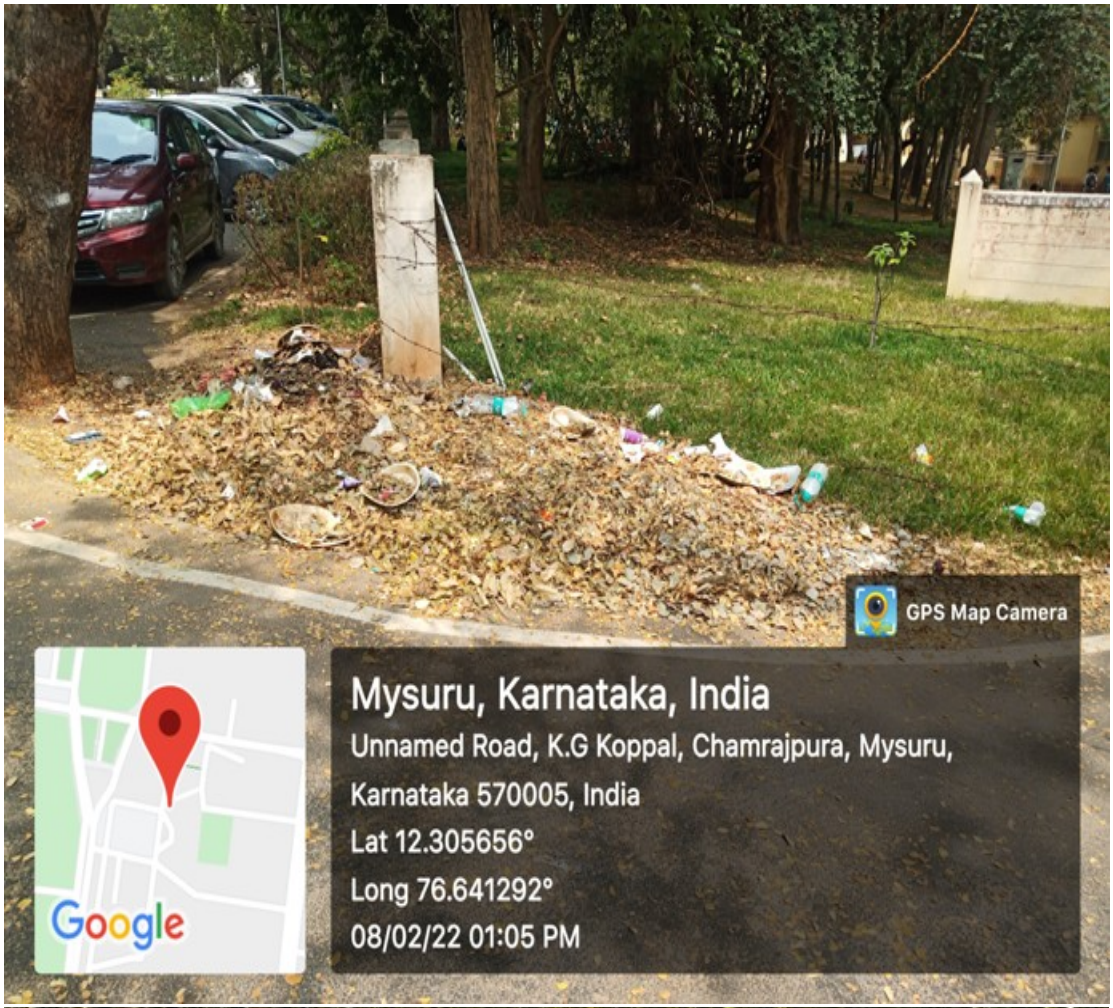
11.6 Dry Waste - Plastic Waste

Plastic waste is a hazardous waste. As we have observed, plastic waste has been reduced in the campus. Students are bringing the lunch boxes and water bottles from home and carrying back to home but still we found some of the plastic bottles, food package covers and single use plastic covers in the campus.

Present way of disposal: All the plastic wastes are dumping in common dustbin with other wastes and without separating it, they are giving it to the corporation.

Recommendation:

1) Educate the students to avoid the plastic usage.
2) Keep the separate dustbin for plastic waste and give it to the corporation. So, that it will help them to recycle the plastic and there will be no need to segregate plastic wastes with other wastes.
3) Keep the awareness board and completely ban the plastic inside the campus.


GPS Map Camera
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Unnamed Road, K.G Koppal, Chamrajpura, Mysuru,
Karnataka 570005, India
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Long 76.641292°
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11.7 Wet Waste – Food Waste

Wet waste is generated by leftover food by the students and staffs in the campus and canteen.

Quantum of wet waste: Food waste is generated around 5 Kgs per day.

Present way of disposal: Some students carry back the food waste to their home and some students will throw in common dustbin. Canteen food waste is fed to animals.

Recommendation:

1) Keep the separate dustbin for food waste.
2) Bio-gas can be produced and can use for LPG if the food waste increased in future.

11.8 Biological Hazardous Waste – Sanitary Pads

Sanitary pads are biological hazardous waste.

Quantum of generation: Around 12000 sanitary pads waste will be generated by the college female students and female staffs per month.

Present way of disposal: Institution has equipped with 6 incinerators. Female students and staffs will dispose the waste sanitary pads into it.

Recommendation: Present way of disposing is appreciable and we don't recommend anything.

11.9 Chemical Waste

Chemical waste is generated from chemistry practical labs.

Quantum of waste generation is less.

Present way of disposal: Chemical waste is buried in a separate place where there are no plants and trees and it has not connected to drainage.

Recommendation: As the present way of disposal is good, we don't recommend any other way of disposal.

11.10 E-Waste – Electrical and Electronic Equipments

E-waste (Electronic waste) describes discarded electrical or electronic devices. Used electronics which are destined for refurbishment, reuse, resale, salvage recycling through material recovery, or disposal are also considered E-waste. Informal processing of E-waste in developing countries can lead to adverse human health effects and environmental pollution.

Electronic scrap components, such as CPUs, contain potentially harmful materials. E-waste is created when an electronic product is discarded after the end of its useful life.

Quantum of waste generation: College has 183 Computers, 30 Projectors, 39 Printers (including scanner) and 5 Multi-functional printers (Copier). Total electronic items are 257 and it weighs approximately 3165 Kgs. It is estimated by considering 5 years of time span of all electronic items as it used for education, about 633 Kgs of E-waste is generated from the electronic items. Mainly computers generate E-waste more.

Present way of Disposal: College is giving the E-waste to regular scrap dealer for disposing.

Recommendation:

1) As per PCB Norms, we recommend to give the waste to authorized E-waste recycler and maintain the proofs.
2) Computer's parts which are working can be used for another systems and which of the parts can repair, after repairing can reuse.
3) For other details please refer Annexure chapter.

11.11 Hazardous Waste – Mercury Waste

Mercury waste will be generated by Tube lights and CFL.

Quantum of waste generation: Institution has 1242 Tube lights and 37 CFLs. Each tube light has 10 MG of mercury and each CFL has 5 MG of mercury. Total mercury content of all tube lights and CFLs will be around 12,605 MG. It is estimated by considering 4-5 years of time span of tube lights and CFLs also taking the average time span of 4 years, around 3151.25 MG of mercury waste is generated from the tube lights and CFLs per year.

Present way of disposal: Tube lights and CFLs are replaced as and when required. After replacing, waste is giving to the corporation.

Recommendation:

1) Dispose of all used tube & CFL as per PCB guidelines. (Enclosed in annexure). These have to be packed in a carton box and handed over separately to authorized e waste collectors. Box has to be labeled to contain fragile and hazardous waste.

2) Converting all Fluorescent lamps to LED is already recommended in this report in the energy audit part. LED lights will not have any mercury content. Hence disposing is easier.

3) Buy only LED tube & bulbs in future.

11.12 Hazardous Waste – Lead Waste

Introduction – Lead waste is generated by Batteries.

Quantum of waste generation: Institution has 121 UPS batteries. Total lead content of all batteries will be about 2662 Kgs. It is estimated by considering 3-5 years of time span of batteries and taking the average time span of 4 years, around 665.5 Kgs of lead waste is generated from the batteries per year.

Present way of waste disposal: As per PCB norms, there are 2 set of rules such as:

1) To give the batteries for the authorized recycler to recycle the lead waste.
2) To return the batteries for money to the seller in a buy back option.

The college is following the second rule and returning the dead batteries to the seller.

Recommendations:

1) Reduce battery AH capacity, after diesel generator is installed. Generator will give additional support. Hence battery can be optimized to support short back up of 30 mins. Presently used batteries are giving about three hours back up
2) Battery life can be extended by use of SMPS charger and switching off output of ups after working hours. This has been explained in energy conservation -UPS chapter
3) Battery maintenance log book has to be maintained near each UPS point to assure proper attending. This will enhance battery life.
4) Battery disposal guidelines given by PCB have to be followed.
5) Batteries have two types of capacity ratings. C10 & C20. C10 rated batteries are usually used for solar. This can be used for UPS also. C10 batteries will have more life than C20 rated batteries. It is recommended to buy C10 rated batteries, even if price is marginally higher.
6) Proofs and records should be maintained while purchasing the batteries and returning it for money. It will be helpful to return the batteries for money and also we can know the amount recovered from it.

11.13 Air Pollution

There is no generator in the college and no exhaust from it. As there is no vehicle parking and no entry for the public vehicle inside the campus, there is no air pollution in the college. So, students are getting fresh and hygienic air from the plants and trees. Also We don't recommend anything.

11.14 Noise Pollution

As explained in the earlier chapter, there is no generator, no vehicle parking inside the campus and no entry for the public vehicle also the institution has been educated the students, not to horn unnecessarily. So, there is no noise pollution in the college and we don't recommend anything.

11.15 Promoting Electrical Vehicles by Charging Points

At present two wheelers and four wheelers usage is less in the college. Institution can promote the electrical two wheeler vehicles by providing charging points.It consumes only 250-300 watts per vehicle. Electrical vehicle will fully get charged in 4 to 6 hours and consumes one unit of electricity. College can provide the facility to charge 3- 4 two vehicles at a time, students can charge their vehicle while attending the class. This facility can be free of cost as this will not create much financial burdon.

Power required for charging two wheeler can be taken from any nearest AC point. We have identified following location, which we found most suitable.

Safe electrical out let of 5 amps capacity in an enclosure with MCB can be provided for charging purpose. Students has to carry their own charger unit. Charger units will change from vehicle to vehicle depending on manufacturer. CCTV monitoring will provide safety required for their chargers. Charger can be housed in same box , where AC out let provided. Only DC output cable will b taken out of box. This will provide additional electrical safety & charger unit security. The facility may cost initial investment of about Rs.5000/-

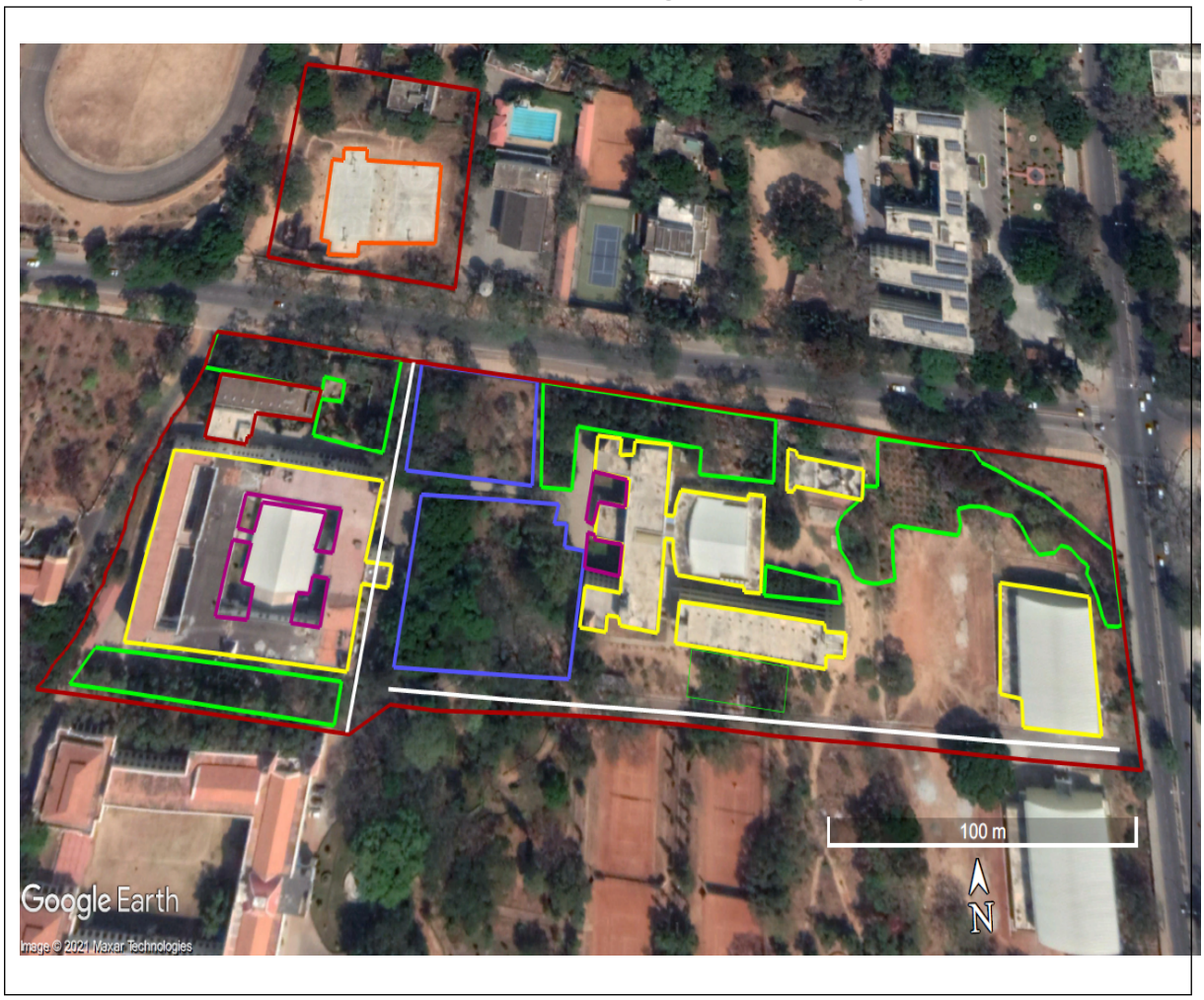
12 Green Audit

12.1 Introduction:

Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of the institute. It aims to analyze environmental practices within and outside the institute which will have an impact on the eco-friendly atmosphere. It imparts a better understanding of Green impact on campus to staff and students.

Green Audit is a valuable means for a college to determine how and where they are using the most water and other resources. It helps to save environment by creating awareness regarding how much the plants and trees are important in mankind, birds and animals life. Thus, Green Audit is necessary for all the Educational Institution.

12.2 Green coverage Inventory



Legend

Total area	ilt up area	Road area	Garden Horticulture	ark	awn	Ground

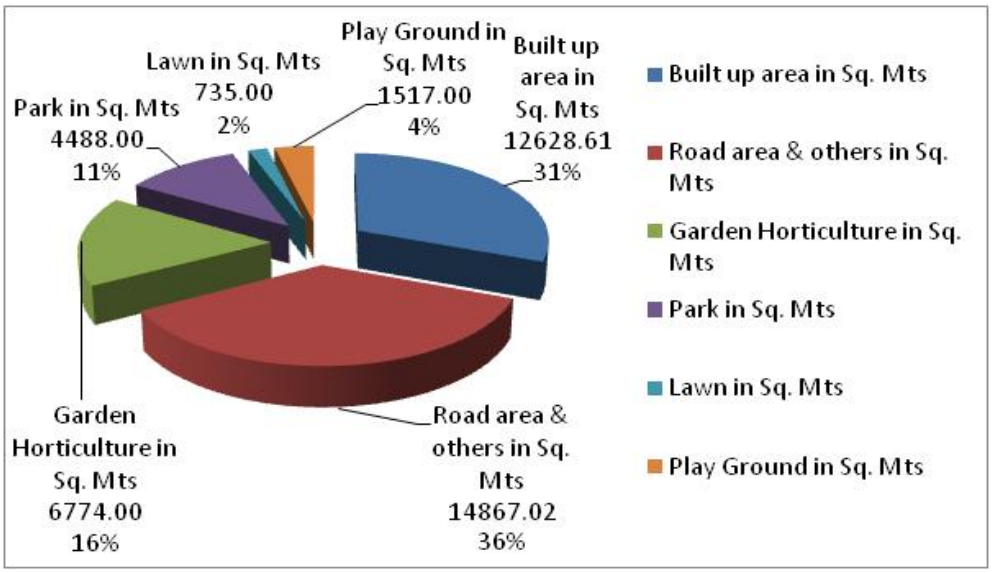
Table

Total area of the campus in Sq. Mts	Built up area in Sq. Mts	Road area in Sq. Mts	Green Area			
			Garden Horticulture in Sq. Mts	Park in Sq. Mts	Lawn in Sq. Mts	Play Ground in Sq. Mts
41,009.62861	12,628.61	1645	6774	4488	735	1517
			Total Green area in Sq. Mts = 13,514			

Total area of the campus in Acres	Built up area in Acres	Road area Acres	Green Area			
			Garden Horticulture in Acres	Park in Acres	Lawn in Acres	Play Ground in Acres
9.32	3.12	2.87	1.67	1.10	0.18	0.37
			Total Green area in Acres = 3.33			

(Note: Boys hostel located at Saraswatipuram is not considered in above data)

Description	Area	%
Built up area in Sq. Mts	12628.61	30.79
Road area & others in Sq. Mts	14867.02	36.25
Garden Horticulture in Sq. Mts	6774.00	16.52
Park in Sq. Mts	4488.00	10.94
Lawn in Sq. Mts	735.00	1.79
Play Ground in Sq. Mts	1517.00	3.70
Total area	41009.63	100.00



Remark: It is appreciable that, even the campus is in the centre of busy area, about 30% of total campus area has green coverage.

12.3 Types of Flora

The area in this campus is immensely diverse with a variety of trees and plants performing a variety of functions. The trees and plants of the college have increased the quality of life, not only the college fraternity but also the people around the college in terms of contributing to our environment by providing oxygen, improving air quality, climate amelioration, conservation of water.

Sl. No.	Family	Plant name
1	Acanthaceae	*Pseuderanthemum carruthersii* (Seem.)
2	Acanthaceae	*Hypoestes*
3	Amaranthaceae	*Gomphrena celosioides* Mart.
4	Annonaceae	*Artabotrys odoratissimus*
5	Annonaceae	*Annona squamosa*
6	Apiaceae	*Trigonella foenum*
7	Apiaceae	*Centella asiatica*
8	Apocynaceae	*Catharanthus roseus*
9	Araceae	*Anthurium plowmanii*
11	Araceae	*Diefffenbachia*
12	Araceae	*Aglaonema*
13	Araceae	*Colocasia*
14	Arecaceae	*Dypsis lutescens*
15	Arecaceae	*Pritchardia* sp.
16	Arecaceae	*Phoenix sylvestris*
17	Arecaceae	*Caryota urens*
18	Asclepiadaceae	*Asclepias curussavica*
19	Asparagaceae	*Dracaena*
20	Asparagaceae	*Chlorophytum comosum vittatum*
21	Asparagaceae	*Aspidistra elatior*
22	Asteraceae	*Synedrella*
23	Asteraceae	*Tagetes*
24	Balsaminaceae	*Impatiens balsamina*
25	Brassicaceae	*Brassica campestris*
26	Cactaceae	*Epiphyllum oxypetallum*
27	Cannaceae	*Canna indica*
29	Crassulaceae	*Kalanchoe tubiflora*
30	Crassulaceae	*Bryophyllum pinnatum* (Lam.) Oken
31	Crassulaceae	*Tradescantia pallida* (Rose) D.R.Hunt
32	Euphorbiaceae	*Acalypha wilkesiana* Müll. Arg.
33	Euphorbiaceae	*Euphorbia hirta*
34	Fabaceae	*Galphimia glauca*
35	Fabaceae	*Medicago sativa*
36	Lamiaceae	*Mentha spicata*
37	Lamiaceae	*Coleus aromaticus*
38	Lamiaceae	*Coleus scutellarioides*

39	Lauraceae	*Persea Americana*
40	Lythraceae	*Cuphea isopilia*
41	Marantaceae	*Maranta arundinaceae*
42	Nyctaginaceae	*Mirabilis jalapa*
43	Oxalidaceae	*Oxalis*
44	Papillionoideae	*Abrus precatorius* L.
45	Pedaliaceae	*Sesamum indicum*
46	Piperaceae	*Peperomia* sp.
47	Plantaginaceae	*Bacopa monnieri*
48	Plantaginaceae	*Russelia equisetiformis*
49	Vitaceae	*Vitis*
50	Zingiberaceae	*Amomum*

1	*Azolla*	
2	*Equisetum*	
3	*Microsorum punctatum*	Pteripdophyte
4	*Nephrolepis*	
5	*Selaginella*	

Sl. No.		

1	*Abrus precatorius L.*	Papillionoideae
2	*Acalypha wilkesiana* Müll.Arg.	Euphorbiaceae
3	*Aglaonema*	Araceae
4	*Amomum*	Zingiberaceae
5	*Annona squamosa*	Annonaceae
6	*Anthurium plowmanii*	Araceae
7	*Artabotrys odoratissimus*	Annonaceae
8	*Asclepias curussavica*	Asclepiadaceae
9	*Aspidistra elatior*	Asparagaceae
10	*Bacopa monnieri*	Plantaginaceae
11	*Brassica*	Brassicaceae
12	*Bryophyllum pinnatum* (Lam.) Oken	Crassulaceae
13	*Canna indica*	Cannaceae
14	*Caryota urens*	Areceae
15	*Catharanthus roseus*	Apocynaceae
16	*Centella asiatica*	Apiaceae
17	*Chlorophytum comosum vittatum*	Asparagaceae (variegated spider plant)
18	*Coleus aromaticus*	Lamiaceae
19	*Coleus scutellarioides*	Lamiaceae
20	*Colocasia*	Araceae
21	*Cuphea hyssopifolia*	Lythraceae
22	*Diefffenbachia*	Araceae
23	*Dracaena*	Asparagaceae
24	*Dypsis lutescens*	Arecaceae
25	*Epiphyllum oxypetallum*	Cactaceae
26	*Euphorbia hirta*	Euphorbiaceae
27	*Galphimia glauca*	Fabaceae
28	*Gomphrena celosioides* Mart.	Amaranthaceae
29	*Hypoestes*	Acanthaceae
30	*Impatiens* sp.	Balsaminaceae
31	*Kalanchoe pumila*	Crassulaceae
32	*Kalanchoe tubiflora*	Crassulaceae
33	*Maranta arundinaceae*	Marantaceae
34	*Medicago sativa*	Fabaceae
35	*Mentha spicata*	Lamiaceae
36	*Mirabilis jalapa*	Nyctaginaceae
37	*Oxalis*	Oxalidaceae
38	*Peperomia sp.*	Piperaceae
39	*Persea americana*	Lauraceae
40	*Phoenix sylvestris*	Arecaceae
41	*Pistia stratiotes*	Araceae
42	*Pritchardia sp.*	Arecaceae
43	*Pseuderanthemum carruthersii (Seem.)*	Acanthaceae (firecracker plant)

44	*Russelia equisetiformis*	Plantaginaceae
45	*Sesamum indicum*	Pedaliaceae
46	*Spathophyllum*	Araceae
47	*Synedrella*	Asteraceae
48	*Tagetes*	Asteraceae
49	*Tradescantia pallida (Rose) D.R.Hunt*	Crassulaceae
50	*Trigonella foenum*	Apiaceae
51	*Vitis*	Vitaceae

FAMILY	NO.	SCIENTIFIC NAME	Common name	Type	Idengifying characters
Acanthaceae	1	*Andrographis paniculata* (Burm.f.) Nees	Nela bevu	Annual Herb	
	2	*Asystasia gangetica* (L.) T.Anderson	Mud desoppu	Perennial Herb	yellow flower
	3	*Asystasia gangetica* (L.) T.Anderson	Chinese Violet	Perennial Herb	purple flowers
	4	*Barleria cristata* L.	Sphatika	Perennial Shrub	white & purple flowers
	5	*Barleria prionitis* L.	haladi gorate/madarangi gida	Perennial Shrub	yellow flowers
	6	*Barleria strigosa* Willd.	Nili gorante	Perennial Herb/subshrub	blue flowers
	7	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	koodali soppu	Perennial Creeping herb	4 leaves at each node
	8	*Crossandra infundibuliformis* (L.) Nees	Kanakambara	Evergreen Undershrub	
	9	*Fittonia* albivenis (Lindl. ex Veitch) Brummitt	Nerve plant	Perennial Creeping herb	
	10	*Graptophyllum pictum tricolor (L.) Griff.*	Caricature plant	Perennial Shrub	Centre white/yellow with bright boarder
	11	Graptophyllum pictum 'Alba Variegata (L.) Griff.	Caricature plant	Shrub	Green and white patches
	12	*Hemigraphis* colorata W.Bull	Iodene plant	herb	
	13	*Justicia betonica L.*	Kaadu kanakaambra	Perennial Herb	Flamingo Flower
	14	*Justicia brandegeeana* Wassh. & L.B.Sm.	Shrimp plant	Perennial Shrub	yellow flower
	15	*Justicia carnea* Lindl. -Radiant	Brazilian plum	Shrub	

			e		
	16	*Justicia carnea* Lindl. -Sango	Flamingo flower	Shrub	
	17	*Justicia gendarussa* Burm.f.	Aduthodagida	Perennial undershrub	green
	18	*Justicia glauca* Rottler	Kaddiyarakinagida	Undershrub	
	19	*Justicia wynaadensis* B.Heyne	Moddu soppu	Shrub	
	20	*Odontonema tubaeforme* (Bertol.) Kuntze	Firespike	Shrub	
	21	*Pseuderanthemum carruthersii* (Seem.)	Purple False Eranthemum	Shrub	variegated
	22	*Ruellia* simplex C.Wright	Desert Petunia	Herb	
	23	*Sanchezia speciosa* Leonard	Zebra plant	Shrub	
	24	*Thunbergia alata* Bojer ex Sims	Black-Eyed Susan Vine	Climber	
	25	*Thunbergia erecta* (Benth.) T.Anderson	Bush Clock Vine, King's Mantle	Shrub	
	26	*Thunbergia fragrans* Roxb.	Sweet Clock-Vine		
	27	*Thunbergia mysorensis* (Wight) T.Anderson	Kamanabillu balli		
Agavaceae					
	1	*Agave sisalana* Perrine	Sisal Agave		
	2	*Agave attenuata*Salm-Dyck	**Swan's Neck Agave**		

Amaranthaceae			
	1	*Eucharis amazonica* Linden ex Planch.	Amazon Lily
	2	*Gomphrena globosa L.*	Globe Amaranth
Amaryllidaceae			
	1	*Zephyranthes candida* (Lindl) Herb.	Zephyr Lily
Anacardiaceae			
	1	*Mangifera indica L.*	Mavina mara
Annonaceae			
	1	*Annona reticulata L.*	
	2	*Polyalthia longifolia* (Sonn.) Thwaites	
Apiaceae			
	1	*Centella asiatica* (L.) Urban	ondelaga
	2	*Hydrocotyl asiatica*	
Apocynaceae			
	1	*Allamanda* sp. L.	Haladi hoo
	2	*Alstonia macrophylla* Wall.	Janthaala mara
	3	*Calotropis gigantea* (L.) Dryand.	Yekke gida
	4	*Carissa carandas* L.	Kavali hoovu
	5	*Cascabela thevetia* (L.) Liipold	Kaadukaasi Kanagalu
	6	*Catharanthus roseus* (L.) G.Don	Nityapushpa
	7	*Nerium oleander* L.	Oleander
	8	*Plumeria pudica* Jacq.	
	9	*Plumeria rubra* L.	Red Frangipani
	10	*Tabernaemontana divaricata* R. Br. Ex Roem. & Schult.	Nandi battalu
Araceae			
	1	*Aglaonema commutatum* Schott.	Chinese evergreen
	2	*Aglaonema nebulosum* N.E.Br.	
	3	*Aglaonema nitidum*	

	4	*Alocasia macrorrhizos* (L.) G. Don	Marasanige
	5	*Anthurium crystallinum* Linden & Andre	
	6	*Anthurium plowmanii* Croat	
	7	*Caladium bicolor* Vent	Heart of Jesus
	8	*Colocasia esculenta* (L.) Schott	Kesavu
	9	*Dieffenbachia seguine* (Jacq.) Schott	Dumb Cane
	10	*Epipremnum aureum* (Linden & André) G.S.Bunting	Money plant
	11	*Pistia stratiotes* L.	Water Lettuce
	12	*Remusatia vivipara* Schott	aadu Gadde
	13	*Rhaphidophora pertusa* (Roxb.) Schott	Dodda Thippali
Araliaceae			
	1	*Polyscias* sp. J.R.Forst. & G.Forst.	
	2	*Schefflera arboricola* (Hayata) Merr.	Ashtalakshmi
Arecaceae			
	1	*Areca catechu* L.	adake mara
	2	*Dypsis lutescence* (H.Wendl.) Beentje & J.Dransf.	Areca palm
	3	*Caryota urens* L.	Fish tail palm
	4	*Cocos nucifera* L.	Tengina mara
	5	*Livistona chinensis* (Jacq.) R.Br. Ex Mart.	Chinese Fan palm
	6	*Rhapis excelsa* (Thunb.) A.Henry	Lady palm
Aristolochiaceae			
	1	*Aristolochia elegans* Mast.	Elegant Dutchman's Pipe
Asclepiadaceae			
	1	*Asclepias curassavica L.*	Scarlet Milkweed
	2	*Calotropis gigantea* (L.) Dryand.	Yekke gida
	3	*Cryptolepis buchanani* Roemer & Schultes	
	4	*Gymnema sylvestre* R. Br.	Madhunashini

	5	*Hoya pubicalyx* R. Br.	Silver wax flowers
Asteraceae			
	1	*Ageratum conyzoides* L.	Oorala gida
	2	*Centratherum puncatatum* Cass.	Porcupine flower
	3	*Chrysanthemum indicum* L.	Shevantige
	4	*Gerebera* sp.	
	5	*Senecio cinerariae* Spreng.	
	6	*Tagetes minima* L.	French Marigold
	7	*Tithonia diversifolia* (Hemsl.) A.Gray	Giant Mexican sunflower
Begoniaceae			
	1	*Begonia grandis* Dryand.	
Bignoniaceae			
	1	*Crescentia cujete* L.	
		Spathodea campanulata P.Beauv	African Tuliptree
	2	*Tecoma capensis* (Thunb.) Lindl.	Cape Honey suckle
	3	*Tecoma stans* (L.) Juss. ex Kunth	Koranechellar
		Tecomaria capensis Salmon	Yelloe bell
Bixaceae			
	1	*Bixa orellana* L.	Rangumaale
Bromiliaceae			
	1	*Aechmea gamosepala* Wittm.	Matchstick Plant
Burseraceae			
	1	*Boswellia serrata* Roxb.	Chilakadhupa
Cactaceae			
	1	*Hylocereus undulatus* (Haworth) Britton & Rose	Queen of nioght/Dragon fruit
	2	*Maihueniopsis ovata* (Pfeiff.) F.Ritter	Prickly Pear
	3	*Opumtia microdasys* (Lehm.) Pfeiff.	Ear Cactus
Caesalipinoidae			

	1	*Bauhinia purpurea* L.	Devakaanchana
	2	Caesalpinia pulcherrima L. (Sw.)	Kenjige
	3	*Cassia alata* L.	dhavala gida
	4	*Delonix regia* (Boj. ex Hook.) Raf.	Kattikaayi mara
	5	*Peltophorum pterocarpum* (DC.) K.Heyne	Copper pod
	6	*Pithecellobium dulce* (Roxb.) Benth.	Seeme hunase
	7	*Tamarindus indica* L.	Hunuse
Caricaceae			
	1	*Carica papaya* L.	Papaya
Cannaceae			
	1	*Canna indica* L.	Kelaa hoo,
Casuarinaceae			
	1	*Casuarina equisetifolia* L.	Surigi mara, Kyasurina
Commelinaceae			
	1	*Callisia repens* Jacq.	Turtle vine
	2	*Tradescantia pallida* (Rose) D.R.Hunt	Moses in the Cradle
Convolvulaceae			
	1	*Cuscuta reflexa* Roxb.	Giant Dodder
	2	*Ipomea cairica* (L.) Sweet	Bekkina Hejje Balli
	3	*Merremia tuberosa* (L.) Rendle	Yellow Morning glory
Crassulaceae			
	1	*Bryophyllum pinnatum* (Lam.) Oken	Life Plant
	2	*Kalanchoe pumila* Baker	Flower dust Plant
	3	*Kalanchoe tubiflora* Eckl. & Zeyh.	Chandelier Plant
Cucurbitaceae			
	1	*Coccinia grandis* (L.) Voigt	Tondikay
Cyperaceae			

	1	*Cyperus alternifolius* L.	Umbrella papyrus
	2	*Cyperus haspan* L.	Umbrella sedge
Dioscoraceae			
	1	*Dioscorea communis* (L.) Caddick &Wilkin	Bitter Yam
Euphorbiaceae			
	1	*Acalypha hispida* Burm.f.	Cat's tail
	2	*Euphorbia antiquorum* L.	Triangular spurge
	3	*Euphorbia hirta* L.	Asthmaplant
	4	*Euphorbia milli* Des Moul.	Crown of thorns
	5	*Euphorbia pulcherrima* Willd. ex Klotzsch	Poinsettia
	6	*Euphorbia tirucalli* L.	Kolgalli
	7	*Excoecaria cochinchinensis* Lour.	Chinese Croton
	8	*Manihot carthaginensis sAllemubsp. glaziovii*	Ceara rubber tree
	9	*Manihot esculnta variegata* Crantz	mara genasu
	10	*Phyllanthus acidus* (L.) Skeels	Nelli Kayi
	11	*Phyllanthus emblica* L.	Bettada nelli kayi
	12	*Ricinus communis* L.	Castor
Gesneriaceae			
	1	*Chrysothemis pulchella* (Donn ex Sims) Decne.	Squarestem
Haloragaceae			
	1	*Myriophyllum aquaticum* (Vell.) Verdc.	Parrot's Feather
Hydrocharitaceae			
	1	*Hydrilla verticillata* (Lf) Royle	Water thyme
	2	*Najas indica* (Willd.) Cham.	Water nymph
	3	*Vallisneria spiralis* L.	kudarebaladagida
Iridaceae			
	1	*Iris domestica* (L.) Goldblatt &Mabb.	Leopard flower
	2	*Neomaria longifolia*	Yellow walking Iris

Lamiaceae			
	1	*Clerodendrum paniculatum* L.	Pedago flower
	2	*Clerodendrum thomsoniae* Balf.f.	
	3	*Leucas aspera* (Willd.) Link	Tumbe gida
	4	*Mentha spicata* L.	Pudina
	5	*Ocimum tenuiflorum* L.	Tulsi
	6	*Plectranthus amboinicus* Lour.	Dodda pathre
Lentibulariaceae			
	1	*Utricularia aurea* Ridl.	
Liliaceae			
	1	*Aloe vera* (L.) Burm.f.	Lolesara
	2	*Asparagus racemosus* Willd.	halavu makkala taayi beru
	3	*Cordyline fruticosa* (L.) A. Chev.	Good Luck Plant
	4	*Gloriosa superba* L.	Glory Lily
	5	*Dracaena reflexa* Lam.	Dragon Tree
	6	*Dracaena surculosa* Lindl.	Golddust Dracaena
	7	*Ruscus aculeatus* L.	Butcher's broom
	8	*Sansevieria cylindrica* Bojer ex Hook.	Cylindrical snake plant
	9	*Sansevieria trifasciata* (Prain) Mabb.	Goddumanji
Lythraceae			
	1	*Lawsonia inermis* L.	Goranti
	2	*Punica granatum* L.	Daadimba
Magnoliaceae			
	1	*Michelia champaca* L.	Sampige
Malpighiaceae			
	1	*Galphimia gracilis* Bratl.	Gold shower
Malvaceae			

	1	*Hibiscus rosasinensis* L.	Dasavala
	2	*Theobroma cacao* L.	Cocoa Tree
Meliaceae			
	1	*Azadiracta indica* A.Juss.	Neem Tree
	2	*Melia dubia* Cav.	Hebbevu
	3	*Swietenia mahagoni* (L.) Jacq.	Big leaf mahagony
Menispermaceae			
	1	*Tinospora cordifolia*	Amritaballi
Mimosoideae			
	1	*Albizia amara* (Roxb.) Boiv.	Chujjulu
	2	*Calliandra haematocephala* Hassk.	Red powder puff
Moraceae			
	1	*Artocarpus heterophyllus*	Halasina mara
	2	*Morus alba*	Hippu nerale
Musaceae			
		Heliconia psittacorum	Parakeet Flower
	1	*Heliconia rostrata*	Hanging heliconia
Myrtaceae			
	1	*Eucalyptus* L'Hér.	
	2	*Pimenta dioica*	Allspice
	3	*Syzygium jambos* L. (Alston)	Rose Apple
Nyctaginaceae			
	1	*Mirabilis jalapa*	Madhyaahna mallige
Nymphaeaceae			
	1	*Nymphaea alba* L.	White water lily
	2	*Nymphaea nouvhali* Burm.f.	Red and Blue water lily
Oleaceae			

	1	*Jasminum multiflorum*	dodda kaadu mallige
	2	*Jasminum sambac* (L.) Aiton	Arabian Jasmine
	3	*Nyctanthes arbor-tristis* L.	Tree of Sorrow
Onagraceae			
	1	*Jussiaea repens*	neeru haavu,
Orchidaceae			
	1	*Cymbidium bicolor* Lindl.	Two coloured cymbidium
	2	*Dendrobium nobile*	
	3	*Epidendrum radicans* Pav.ex Lindl.	Red Crucifix
	4	*Pholidota imbricata* Hook.	Necklace Orchid
	5	*Spathoglottis plicata* Blume.	Phillipine Ground Orchid
	6	*Vanda* Gaud. ex Pfitzer	Vanda
	7	*Vanilla planifoli* Jacks. ex Andrews	Vanilla Creeper
Papilionoideae			
	1	*Abrus precatorius* L.	Gulaganji
	2	*Crotalaria* sp.	Senabu
	3	*Erythrina* sp.	
Pandanaceae			
	1	*Pandanus sp*	Taale hu
Phytolocaceae			
	1	*Rivinia humilis* L.	Coralberry
Plantaginaceae			
	1	*Russelia equisetiformis* Schlecht. & Cham.	Firecracker plant
Poaceae			
	1	*Bambusa vulgaris* Schrad. ex J.C.Wendl	Bamboo
	2	*Chrysopogon* Trin.	Laavancha
	3	*Cymbopogon citratus* (DC.) Stapf	Lemon Grass
Pontederiaceae			

	1	*Eichhornea crassipes* Mart.	Water Hyacinth
Proteaceae			
	1	*Grevillea robusta* A.Cunn, ex R.Br.	Silver oak Tree
Ranunculaceae			
	1	*Clematis gouriana* Roxb. Ex DC.	Nelakuma
Rosaceae			
	1	*Rosa chinensis* Jacq.	Bengal rose
Rubiaceae			
	1	*Coffee arabica* L.	Coffee
	2	*Ixora coccinea* L.	Rukmini
	3	*Pentas lanceolata* (Forssk.) Deflers	Pentas
Rutaceae			
	1	*Citrus reticulata* Blanco.	Mandarin Orange
	2	*Citrus limon* (L.) Osbeck	Lemon
	3	*Ruta graveolens* L.	Naagadaali
Santalaceae			
	1	*Santalum album* L.	Srigandha
Sapotaceae			
	1	*Manilkara zapota* (L.)P.Royen	Sapota
Simaroubaceae			
	1	Simarouba glauca DC.	Lakshmi Taru
Solanaceae			
	1	*Solanum diphyllum* L.	Twoleaf Nightshade
	2	*Withnia somnifera* (L.) Dunal	Ashwagandha
Sterculiaceae			
	1	*Guazuma tomentosa*	Rudrakshi
Strelitziaceae			

	1	*Strelitzia nicolai* Regel & K. Koch	White Bird of Paradise
	2	*Sterlitzia reginae* Banks	Bird of Paradise
Verbenaceae			
	1	*Duranta erecta* L.	Hucchelasi
	2	*Lantana camara* L.	Lantavaani
	3	*Vitex negundo* L.	Nochi
Vitaceae			
	1	*Vitis quadrangularis* (L.) Wall. Ex Wight	vajravalli
Zingiberaceae			
		Alpinia zerumbet (Pers.) B.L.Burtt &R.M.	Light galangal
	1	*Cheilocostus speciosus* (J.Konig) C.Specht	Pushkaramula
	2	*Chamaecostus cuspidatus* (Nees & Mart.) C. Specht & D.W.Stev.	Spiral Flag
	3	Costus sp. L.	
	4	*Curcuma longa* L.	Turmeric
	5	Etlingera elatior (Jack) R.M.Sm.	Torch Ginger
	6	*Zingiber zerumbet*	Bitter ginger

12.4 Bio-diversity of Aves in the Campus of Yuvaraja's college, Mysuru.

The word Bio-diversity is pre-eminent one which refers to the variety of life and its forms. Biodiversity is the natural array of the species and their relationship between them. This involves the variability of the life in given area and in space of time. The most important aspects of the biodiversity is it is unevenly distributed on our planet. In other words, different ecosystem harbors different flora and fauna communities. This can be measured on many levels ranging from the ecosystem to genetic level. It is figured as richness in variety and variability of all life forms in a given region. Quantifying the differences among biological communities as a major step towards understanding how and why biodiversity is distributed in this way. The Indian subcontinent comprises rich diversity in forest, wetlands, marine and desert ecosystem for this purpose it is well known as one of 12th mega diverse countries in the world. Here in this article we have attempted to address the diversity of avifauna in the Yuvaraja's campus, University of Mysore, Mysore.

The Yuvaraja's college constituent Autonomous instituteof University of Mysore is one of the premier organizationestablished in the year 1927, by Sri Krishnaraja Wodeyar prominent Maharajaof Mysuru by laying the foundation stone for the college in the presence of the Pandit Motilal Nehru (Father of first Prime minister of India), Sir Mirza Ismail (Dewan of Mysore) and Rajatantra Pravina Sir Bajendranth Seal (Vice–Chancellor) of University of Mysore. By the time of Silver Jubilee in the year 1954 it was retitled as Yuvaraja's college by the Maharaja Sri Jayachamraja Wodeyar. As a leading academic centre for its educational excellence the collegehas been recognized by UGC under 2(f) and 12(B) of UGC Act and Government of Karnataka. The institution was conferred the status of College with Potential for Excellence in 2010.Apart from this excellent quality of higher education the university grants commission conferred autonomous status to the college in the year 2005 and it was extended up to 2020.Quality enhancement, distinction and sustenance being the hallmark of this institution is further proved during the third cycle of re-accreditation by NAAC. The College constantly aspires to scale great heights in its quest for excellence in imparting human, intellectual, spiritual and moral knowledge for the present generation. In the year 2028 Yuvaraja′s College steps into its 100th year of its existence and service to the nation.

Today, this institute is sheltered in the green belt which is extended to the centre of city .This green piece of land harbors many old flora planted many years ago which wrap up good number of fauna justifying the richness and diversity of living forms in around this campus. Here author have tried to calibrate the marvelous Avifauna in around the campus when came across during routine work.

Ecologically life is supported bydiversity of life forms in one way or in other way which provides raw material for the functioning the present ecosystems. For instance

birds are momentous in plant reproduction as seed dispersers and act as roller in pollination. Along with this it helps in maintain sustainable population levels of their prey and predator species and, after the death, it provides food for scavengers and decomposers. The study of birds (ornithology) has been contributed remarkably to the advancement in the field of community ecology. The avifauna is best indicator of ecosystem stability. Like other organisms birds also plays key role in keeping the ecosystem health. In nature the birds are of significance as pollinators and seed dispersal. The study of the biological diversity of avian in the particular area has now gained a wide global attention.

Role of conservation of birds has been least considered during modification of vegetative habitats and also urbanization of particular habitat. The present study was conducted to know the status of the birds in campus of the Yuvaraja's College University of Mysore. The purpose of survey of Avian was not only to assess the number of the species found in and around the campus but also intended to assess the relationship between habitat and the composition and distribution of avifauna in college campus. A survey was conducted by the direct observation of the birds from 6 to 7.30 am in the early morning and in the evening around 5.00 to 6.30pm from the August to December using the binocular in the college campus.According to the survey conducted in the campus comprises around 30 species of Avian fauna which belongs to 20 familyand 9 orders. given in the Table 1. The order Passeriformes are the commonly spotted in around the campus comprising 13 species. The order Coraciiformes comprises single species with rarely found here and there in the campus.

Table 1. Shows the presence of the Avian fauna in the campus of Yuvaraja's college

Sl	Common Name	Zoological Name	Family	Order	Food Habit	Status
1	Ashy Prinia	*Priniasocialis*	Cisticolidae	Passeriformes	Insectivorous	R
2	Asian brown fly catcher	*Muscicopadasuerica*	Muscicapidae	Passeriformes	Insectivorous	M
3	Bee eater	*MeropsPhillppnus*	Meropidae	Coraciiformes	Insectivorous	R
4	Black Kite	*Milvus migrans*	Accipitridae	Accipitriformes	Scavengers	R
5	Blue Rock Pigeon	*Columba livia*	Columbidae	Columbiformes	Seed Eater	R
6	Brahminy Kite	*Haliasturindus*	Accipitridae	Accipitriformes	Carnivorous	R
7	Bulbul	*Pycnonotus barbatus*	Pycnonotidae	Passeriformes	Frugivorous	R
8	Cattle Egret	*Bubulcuscoramandus*	Ardeidae	Pelecaniformes	Insectivorous	R
9	Coppersmith Barbet	*Psilopogonhaemacephalus*	Megalaimdae	Piciformes	Frugivorous	R
10	Drongo	*Dicrurusmacrocercus*	Dicruruidae	Passerine	Insectivorous	R
11	Golden Oriole	*Orioluskundoo*	Oriididae	Passeriformes	Frugivorous	R
12	Great Tit	*Parus major*	Paridae	Passeriformes	Insectivorous	R
13	Hoopoe	*Upupa epops*	Upuidae	Bucerotiformes	Insectivorous	R
14	Hornbill	*Anthracoceroscoronatus*	Bucerotidae	Bucertiformes	Frugivorous	R
		Corvus splendens	Psittaculidae	Passeriformes	Scavenger	

15	House Crow					R
16	Indian Pond Heron	Ardeolagrayii	Ardeidae	Pelecaniformes	Water bird Insects, Fish, Amphibians, etc;	R
17	Jungle Crow	*Corvus culminatus*	Psittaculidae	Passeriformes	Scavenger	R
18	Magpie Robin	Copsychussaularis	Muscicapidae	Passeriformes	Insectivorous	R
19	Myna	*Acridotheres tristis*	Sturnidae	Passeriformes	Insectivorous	R
20	Red Naped Ibis	*Pseudibispapillosa*	Threskiornithidae	Pelecaniformes	Insectivorous	R
21	Rose ringed Parakeet	*Psittaculakrameri*	Psittaculidae	Psittaciformes	Frugivorous	R
22	Shikra	*Accipter badius*	Accipitridae	Accipitriformes	Carnivorous	R
23	Small Minivet	*Precrocotuscinnamomeus*	Campephagidae	Passeriformes	Frugivorous	R
24	Spotted Dove	*Spilopellachenensis*	Columbidae	Columbiformes	Seed Eater	R
25	Spotted Owlet	*Athene brama*	Strigidae	Strigiformes	Carnivorous	R
26	Sunbirds	*Cinnyris asiaticus*	Nectarinidae	Passeriformes	Nectarivorous	R
27	Tickel's blue Flycatcher	*Cyomistickelliae*	Muscicapidae	Passeriformes	Insectivorous	R
28	Warbler	*Phylloscopussibilitrix*	Phylloscopidae	Passeriformes	Insectivorous	M
29	White breasted Kingfisher	*Psilpogonvindis*	Megalaimdae	Piciformes	Insects, worms, Fishes,Amphibians, Reptiles etc	R
30	White Cheeked Barbet	*Psilopogonviridis*	Megalaimdae	Piciformes	Frugivorous	R

R- Resident of YCM: M- Migrant in YCM

Table 2 Shows the list of the lost plant and Avifauna in the Yuvaraja's college campus

1	Tickel's blue Flycatcher	*Cyomistickelliae*	Passeriformes	***Acacia species***	Insectivorous	R
2	Warbler	*Phylloscopussibilitrix*	Passeriformes	***Polyalthia longifolia***	Insectivorous	M
3	House Crow	*Corvus splendens*	Passeriformes	***Azadirachta indica*** ***Cocus nucifera*** ***Dilonox regia*** ***Peltaphorum***	Scavenger	R

12.5 Water Bodies

There are no natural or artificial water bodies such as small ponds and water fountains inside or outside the institute.

Recommendation:

It is recommended to have an artificial mini pond or fountain in the campus. This will help to have good landscape along with building eco system also looks good and beautiful for this green campus.

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13. Awareness activities

Awareness plays major role in protecting energy & environment. Educating the students in need & approach will act as accelerator in deploying recent trends. This will also help them in their career.

Institution has kept awareness boars in many places. Adding some more posters and boards are in process.

Institution has done different programs in both inside campus and outside campus. Details of such programs are given below.

Date/Year	Activities	No. of participants
2018	Art Modelling Form Waste Material	15
2018	Art Modelling Form Waste Material	15
16/02/2019	Workshop on Food Safety Auditing	40
2018-2019	Swacch Bharath	8
2018-2019	Swacch Andolana	10
2018-2019	Swacch Bharath	8
18/09/2018	Nutrition Awareness Talk	6
30/12/2018	Seed Sowing Fest	50
2018-2019	Food Adulteration Awareness Program	40
25/09/2018	Swacch Bharath	6
2018-2019	Seed Sowing Fest	50
22/04/2019	Earth Day Celebration	100
25/09/2018	Swacch Bharath Abhiyan	1000
14/09/2019	Shramadan	4
24/09/2019	Shramadan	5

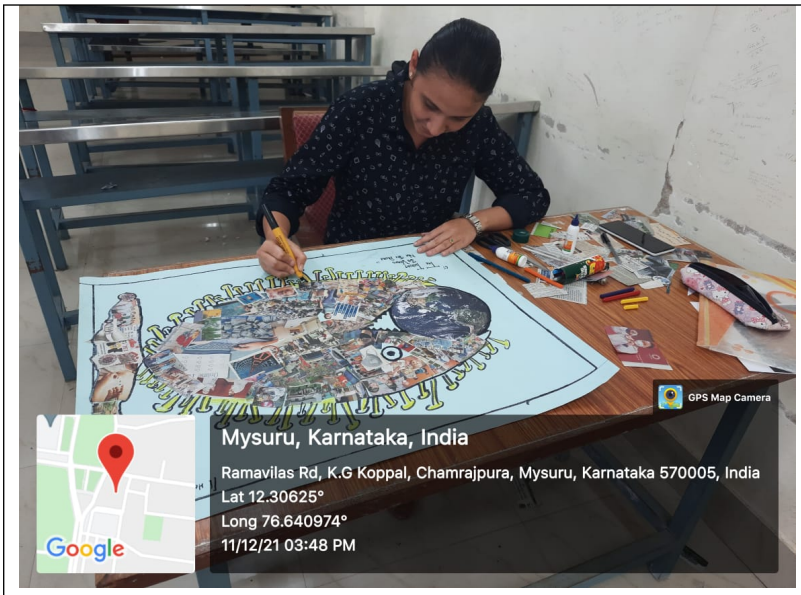
From May 2020 to	August 2021			
Title of the activities	Organising unit/agency/ collaborating agency	Date	Number of teachers participated	Number of students participated
PLANTING FRUIT PLANTS' Programme held on 27TH September'2019	NSS Unit Yuvaraja's College, Mysuru	25-09-2020	3	5
PLANTING FRUIT PLANTS'	NSS Unit Yuvaraja's College, Mysuru	29-09-2020	25	15

Programme held on 27TH September'2019				
Essay Writing compitition	NSS Unit Yuvaraja's College, Mysuru	03-10-2020	2	20

Institution has also motivated and promoted students to involve in the competitions and activities done by other organisations and adopt in their home also.

Such as:

- Planting Samplings.
- Plastic Eradication.
- Cleaning the surroundings.
- Waste Segregation using colour coded and marked dustbins.
- Drawings and posters.
- Attending Talks & webinar related to environment conservation.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Burn Fat
Not Fuel

ANNEXURES