



<b>Course Name:</b>	<b>Elements of Electrical and Electronics Engineering</b>	<b>Semester:</b>	<b>I</b>
<b>Date of Submission:</b>	<b>31 / 01 / 2022</b>	<b>Batch No:</b>	<b>A2</b>
<b>Faculty Name:</b>	<b>Maruti Zalte</b>	<b>Roll No:</b>	<b>16010121045</b>
<b>Faculty Sign &amp; Date:</b>		<b>Grade/Marks:</b>	<b>/ 20</b>

**Internal Assessment: 2**

**Case study on Electricity consumption and billing of a home**

**1. What is electrical power and energy? What are their units?**

**Ans:** Electric power:

Electric power is the rate at which work is done or energy is transformed in an electrical circuit. Simply put, it is a measure of how much energy is used in a span of time.

**The SI unit of power is the watt or one joule per second.**

1 Watt (W) = 1 Joule / Second (J/s)

$$P = IV = I^2R = \frac{V^2}{R}$$

Where **V** is Volts, **I** is Current & **R** is the Electrical Resistance.

**Electric Energy:**

Electrical energy is the energy derived from electric potential energy or kinetic energy of the charged particles. In general, it is referred to as the energy that has been converted from electric potential energy. We can define electrical energy as the energy generated by the movement of electrons from one point to another. **SI unit of electrical energy is Joule.**

**1 Joule** = 1 Volt x 1 Ampere x 1 Second

**2. What is 1-unit electrical energy?**

**Ans:** Unit Electricity is the amount of electrical energy consumed by a load of 1 kW power rating in 1 hour. It is basically measurement unit of electrical energy consumption in Joule.

1 Unit Electricity = 1 kWh

$$= 1 \text{ kW} \times 1 \text{ Hour} = 1000 \text{ W} \times 3600 \text{ seconds} = 3.6 \times 10^6 \text{ Joule}$$

**1. Estimate The Electricity Consumption of Your Home For 2 Months (Units/Month)  
December & January. (Following Table Is Applicable as Usual)**

**For December 2021: -**

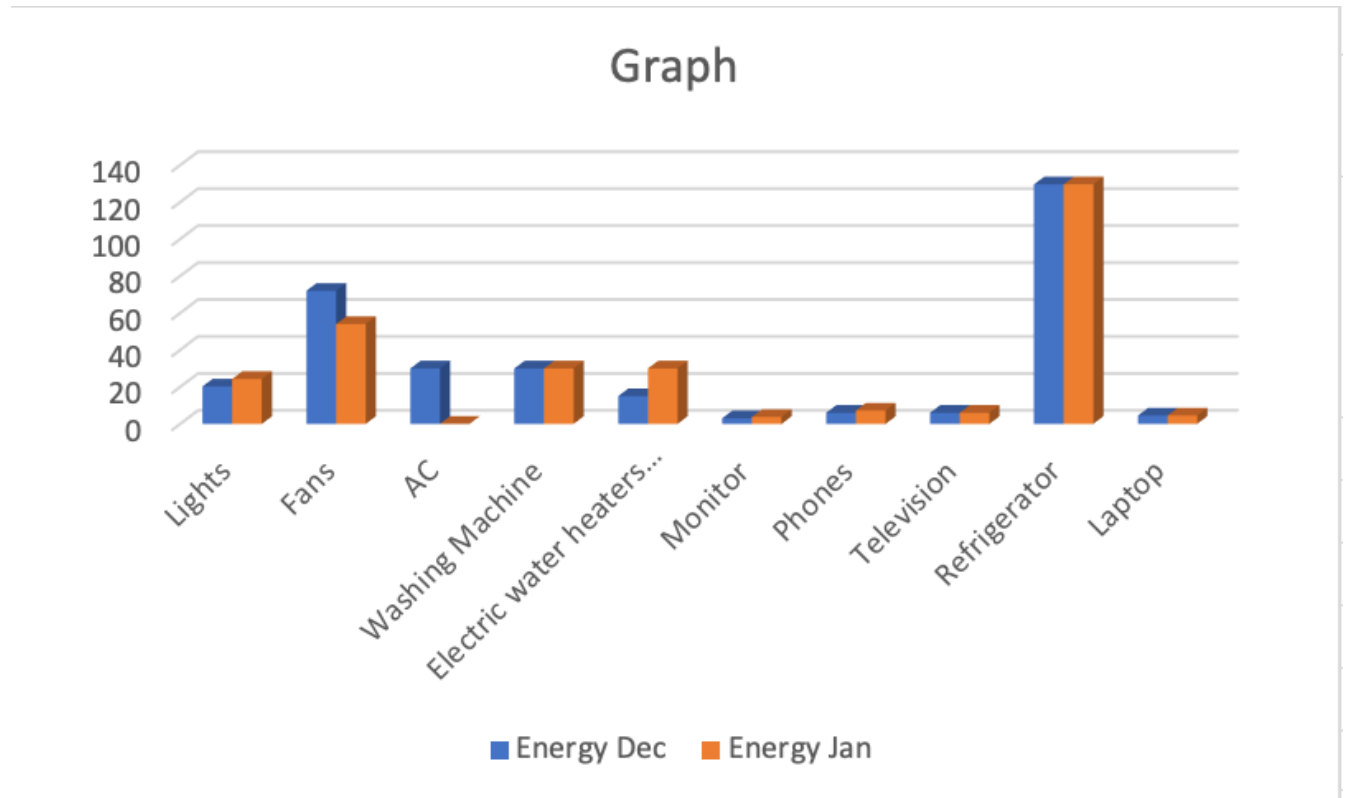
Sr. No.	Appliances	Power Rating (watts/appliance) (a)	No of appliances (b)	Utilization in Hours per day (c)	Energy in Wh/1000 (units)/day (d=axbxc)/1000	Energy units/month dx30
1	Lights	10 7	10 5	5 5	0.5 0.175	15 5.25
2	Fans	30	4	20	2.4	72
3	AC	1000	1	1	1	30
4	Washing Machine	1000	1	1	1	30
5	Electric water heaters (Geysers )	500	1	1	1	15
6	Monitor	25	1	4	0.1	3.0
7	Phones	10	4	5	0.2	6.0
8	Television	100	1	2	0.2	6.0
9	Refrigerator	180	1	24	4.8	129.6
10	Laptop	30	1	5	0.15	4.5
<b>Total energy (Units/month)</b>						<b>316.35</b>



**For January 2022: -**

Sr. No.	Appliances	Power Rating (watts/appliance) (a)	No of appliances (b)	Utilization in Hours per day (c)	Energy in Wh/1000 (units)/day (d=axbxc)/1000	Energy units/month dx30
1	Lights	10 7	10 5	6 6	0.6 0.21	18 6.3
2	Fans	30	4	15	1.8	54
3	AC	1000	1	0	0	0
4	Washing Machine	1000	1	1	1	30
5	Electric water heaters (Geysers )	500	1	2	1	30
6	Monitor	25	1	5	0.125	3.75
7	Phones	10	4	6	0.24	7.2
8	Television	100	1	2	0.2	6.0
9	Refrigerator	180	1	24	4.8	129.6
10	Laptop	30	1	5	0.15	4.5
<b>Total energy (Units/month)</b>						<b>289.35</b>

Plot a bar Graph showing appliances on x-axis and energy (units/month/appliance) on Y-axis. Draw the graph for both the months (Use can Microsoft Excel to plot graphs)



4. Compare actual electricity units and bill (Rupees) with your estimation (Use electricity bill of recent month of your home. Attach copy of the same with assignment)

Ans.

For December: -

Energy consumption	Energy units/month	Billing Rate Rs./Unit	Total (Rs) (without tax)
Estimated	316.35	0 - 100 units: 1.75 101 - 300 units: 4.30 301 - 500 units: 7.75 Above 500 units: 8.45	1159.00
Actual	314	0 - 100 units: 1.75 101 - 300 units: 4.30 301 - 500 units: 7.75 Above 500 units: 8.45	1143.50

<p style="text-align: center;"><b>Meter No. ST059049</b></p> <p><b>Closing Rdg.(a) 30,314.00</b></p> <p><b>Opening Rdg.(b) 30,020.00</b></p> <p><b>Difference(c = a-b) 294.00</b></p> <p><b>Multiplication factor (MF) 1.00</b></p> <p><b>Adjustment(d)</b></p> <p><b>Units[( c*MF) + d] 294</b></p> <p style="text-align: center;"><b>Total Metered Units: 294</b> <b>Total Billed Units: 314</b></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">Sr. No.</th> <th style="width: 75%;">Your Bill Details</th> <th style="width: 20%;">Rs.</th> </tr> </thead> <tbody> <tr><td>1</td><td>Energy Charges</td><td>1143.50</td></tr> <tr><td>2</td><td>Fixed Charges</td><td>140.00</td></tr> <tr><td>3</td><td>Fuel Adjustment Charges*</td><td>0.00</td></tr> <tr><td>4</td><td>Cross Subsidy Surcharge AEML @ Rs. 0.16 /kWh</td><td>47.04</td></tr> <tr><td>5</td><td>Wheeling Charges AEML @ Rs. 1.46 /kWh</td><td>429.24</td></tr> <tr><td>6</td><td>Wheeling Charges TPC-D</td><td>0.00</td></tr> <tr><td>7</td><td>Regulatory Asset Charges</td><td>0.00</td></tr> <tr><td>8</td><td>Green Power Tariff</td><td>0.00</td></tr> <tr><td>9</td><td>Electricity Duty @ 16 %</td><td>281.56</td></tr> <tr><td>10</td><td>Tax on Sale of Electricity @ Rs. 0.2604</td><td>81.77</td></tr> <tr><td>11</td><td>Adjustments</td><td>(cr) 0.11</td></tr> <tr><td>12</td><td><b>Total (1 to 11)</b></td><td><b>2123.00</b></td></tr> <tr><td>13</td><td>Delayed Payment Charges</td><td>0.00</td></tr> <tr><td>14</td><td>Interest on Arrears</td><td>0.00</td></tr> <tr><td>15</td><td>Outstanding Amount (Pay immediately)</td><td>0.00</td></tr> <tr><td>16</td><td>Other Charges</td><td>0.00</td></tr> <tr><td>17</td><td>Additional charges for Consumer Funded Job</td><td>0.00</td></tr> <tr><td>18</td><td>Moratorium Amount</td><td>0.00</td></tr> <tr><td>19</td><td>Advance Payment Available</td><td>0.00</td></tr> <tr><td>20</td><td>Discount for digital payment</td><td>(cr) 5.00</td></tr> <tr><td>21</td><td>Tax collection at source</td><td>0.00</td></tr> <tr><td>22</td><td><b>Net Bill Amount (11 to 21)</b></td><td><b>2118.00</b></td></tr> <tr><td>23</td><td>Discount (if paid on / before 14.12.2021)</td><td>(cr) 18.00</td></tr> <tr><td>24</td><td><b>Bill Amount by Discount Date</b></td><td><b>2100.00</b></td></tr> <tr><td>25</td><td>Security Deposit (SD) Due (Invoice no.: 5530074628 )</td><td>680.00</td></tr> <tr><td colspan="2"></td><td style="text-align: right;">E. &amp; O.E.</td></tr> </tbody> </table>	Sr. No.	Your Bill Details	Rs.	1	Energy Charges	1143.50	2	Fixed Charges	140.00	3	Fuel Adjustment Charges*	0.00	4	Cross Subsidy Surcharge AEML @ Rs. 0.16 /kWh	47.04	5	Wheeling Charges AEML @ Rs. 1.46 /kWh	429.24	6	Wheeling Charges TPC-D	0.00	7	Regulatory Asset Charges	0.00	8	Green Power Tariff	0.00	9	Electricity Duty @ 16 %	281.56	10	Tax on Sale of Electricity @ Rs. 0.2604	81.77	11	Adjustments	(cr) 0.11	12	<b>Total (1 to 11)</b>	<b>2123.00</b>	13	Delayed Payment Charges	0.00	14	Interest on Arrears	0.00	15	Outstanding Amount (Pay immediately)	0.00	16	Other Charges	0.00	17	Additional charges for Consumer Funded Job	0.00	18	Moratorium Amount	0.00	19	Advance Payment Available	0.00	20	Discount for digital payment	(cr) 5.00	21	Tax collection at source	0.00	22	<b>Net Bill Amount (11 to 21)</b>	<b>2118.00</b>	23	Discount (if paid on / before 14.12.2021)	(cr) 18.00	24	<b>Bill Amount by Discount Date</b>	<b>2100.00</b>	25	Security Deposit (SD) Due (Invoice no.: 5530074628 )	680.00			E. & O.E.
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<p><b>Sanctioned load (kW) : 8.00</b></p> <p><b>Connected Load (kW) : 8.00</b></p> <p><b>Last Bill amt. : Rs.2,438.00</b></p> <p><b>Last payment received : Rs.2,438.00</b></p> <p><b>Payment received on : 27.11.2021</b></p> <p><b>Payment received mode : UPI</b></p>	<p style="text-align: center;"><b>ELECTRICITY TARIFF SCHEDULE w.e.f 01.04.2021</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">LT I (B) :LT-RESIDENTIAL</th> <th style="width: 10%;">Energy Charges (₹ /kwh)</th> <th style="width: 10%;">RA Charges (₹ /kwh)</th> <th style="width: 10%;">CSS Charges (₹ /kwh)</th> <th style="width: 10%;">Wheeling Charges (₹ /kwh)</th> <th style="width: 10%;">Fixed/ Demand Charges(₹)</th> <th style="width: 10%;">ED %</th> <th style="width: 10%;">TOSE (₹ /kwh)</th> </tr> </thead> <tbody> <tr><td>000-100 Units</td><td>1.75</td><td>0.00</td><td>0.16</td><td>1.46</td><td>140</td><td>16.00</td><td>0.2604</td></tr> <tr><td>101-300 Units</td><td>4.30</td><td>0.00</td><td>0.16</td><td>1.46</td><td>140</td><td>16.00</td><td>0.2604</td></tr> <tr><td>301-500 Units</td><td>7.75</td><td>0.00</td><td>0.16</td><td>1.46</td><td>140</td><td>16.00</td><td>0.2604</td></tr> <tr><td>Above 500</td><td>8.45</td><td>0.00</td><td>0.16</td><td>1.46</td><td>140</td><td>16.00</td><td>0.2604</td></tr> </tbody> </table> <p><small>1) Residential (3 Phase) : Addl. Fixed charges of 140/10 kW or part thereof above 10kW shall be payable. 2) Electricity Duty as per G.O.M Notification No. ELD 2016/CR 252/ENERGY-1 of 31.10.16. 3) Tax on Sale of electricity as per G.O.M Notification No. VVK-2018/CR-161/Energy-1 of 26-12-18.</small></p>	LT I (B) :LT-RESIDENTIAL	Energy Charges (₹ /kwh)	RA Charges (₹ /kwh)	CSS Charges (₹ /kwh)	Wheeling Charges (₹ /kwh)	Fixed/ Demand Charges(₹)	ED %	TOSE (₹ /kwh)	000-100 Units	1.75	0.00	0.16	1.46	140	16.00	0.2604	101-300 Units	4.30	0.00	0.16	1.46	140	16.00	0.2604	301-500 Units	7.75	0.00	0.16	1.46	140	16.00	0.2604	Above 500	8.45	0.00	0.16	1.46	140	16.00	0.2604
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Difference between Billed & Metered units is due to wheeling loss of AEML Network (LT:6.43% & HT: 1.59%).  
FAC : 0\*0.0000

For making bill payment through cheque, please ensure to submit cheque two working days in advance, so that payment will be realized on discount/ due date. Cash Payment can be accepted limited to 5,000/-

Month	Total Metered Units	Total Billed Units
NOV 2021	321	343
OCT 2021	282	301
SEP 2021	277	296
AUG 2021	345	369
JUL 2021	324	346
JUN 2021	468	500
MAY 2021	394	421
APR 2021	307	328
MAR 2021	227	243
FEB 2021	235	251
JAN 2021	256	274
DEC 2020	298	318
NOV 2020	369	394
OCT 2020	332	355
SEP 2020	340	363

**CONSUMPTION PATTERN: UNITS - KWH**

**IMPORTANT NOTICE**

1) In all your correspondence, please mention Consumer No. & Bill No.(s). 2) All Bills, even if disputed, have to be paid fully. Adjustments if any, will be made in the subsequent bills. 3) Bill amount has been rounded off to the nearest Rupee. 4) If bills are short paid / paid after the due date, a one-time Delay Payment Charge (DPC) will be levied @ 1.25% of the total amount of the bill. 5) The interest will be payable from 2nd month after due date, on the amount of the bill plus the one-time DPC, interest on arrears is chargeable upto 3 months : 12% p.a., beyond 3 months : 15% p.a. 6) Cash discount of 1% will be allowed on the monthly bill (excluding duty & taxes) if payment is received by the discount date indicated in the bill which is 7 days. 7) Kindly note that theft of electricity in any manner whatsoever will attract penal action under the Electricity Act 2003. 8) Using your electricity connection for purposes other than that provided for is a tariff violation & may lead to disconnection/ penal action.

**Cash payment is limited to Rs. 5,000/- per month.** 1) In case of any complaints, please reach out to us at our Toll Free No., WhatsApp or Email. 2) In case complaint is not resolved, you may also approach us through web based Internal Consumer Redressal System (ICRS) available at Customer portal - <https://cp.tatapower.com> 3) Further, in case of unresolved complaints, you may approach Consumer Grievance Redressal Forum (CGRF) online under grievances section at Customer portal. Every grievance must be submitted in writing to the forum in the format set out in Schedule A as per MERC (Consumer Grievance Redressal Forum & Electricity Ombudsman) Regulation, 2020 downloadable from the customer portal. 4) Location of the Ombudsman: Maharashtra Electricity Regulatory Commission, 608-608, Keshava Building, Bandra-Kurla Complex, Mumbai-400051. **Cash Payment not accepted on Bank Holidays.**

Regd. Office: The Tata Power Co. Ltd., 24 Homi mody Street, Mumbai 400001, CIN : L28920MH1919PLC000567. PAN no.: AAAC0054A / GST No: 27AAACT0054A1Z1. HSN Code: 27160000



**For January: -**

Energy consumption	Energy units/month	Billing Rate Rs./Unit	Total (Rs) (without tax)
Estimated	289.35	0 - 100 units: 1.75 101 - 300 units: 4.30 301 - 500 units: 7.75 Above 500 units: 8.45	987.7
Actual	301	0 - 100 units: 1.75 101 - 300 units: 4.30 301 - 500 units: 7.75 Above 500 units: 8.45	1042.75

**Meter No. ST059049**

**Closing Rdg.(a) 29,699.00**

**Opening Rdg.(b) 29,417.00**

**Difference(c = a-b) 282.00**

**Multiplication factor (MF) 1.00**

**Adjustment(d)**

**Units[( c\*MF) + d] 282**

**Total Metered Units: 282**  
**Total Billed Units: 301**

Sr. No.	Your Bill Details	Rs.
1	Energy Charges	1042.75
2	Fixed Charges	140.00
3	Fuel Adjustment Charges*	0.00
4	Cross Subsidy Surcharge AEML @ Rs. 0.16 /kWh	45.12
5	Wheeling Charges AEML @ Rs. 1.46 /kWh	411.72
6	Wheeling Charges TPC-D	0.00
7	Regulatory Asset Charges	0.00
8	Green Power Tariff	0.00
9	Electricity Duty @ 16 %	262.33
10	Tax on Sale of Electricity @ Rs. 0.2604	78.38
11	Adjustments	(cr) 0.30
12	<b>Total (1 to 11)</b>	<b>1980.00</b>
13	Delayed Payment Charges	0.00
14	Interest on Arrears	0.00
15	Outstanding Amount (Pay immediately)	0.00
16	Other Charges	0.00
17	Additional charges for Consumer Funded Job	0.00
18	Moratorium Amount	0.00
19	Advance Payment Available	0.00
20	Discount for digital payment	(cr) 4.00
21	Tax collection at source	0.00
22	<b>Net Bill Amount (11 to 21)</b>	<b>1976.00</b>
23	Discount (if paid on / before 13.10.2021)	(cr) 16.00
24	<b>Bill Amount by Discount Date</b>	<b>1960.00</b>
25	Security Deposit (SD) Due (Invoice no.: 5530074628 )	680.00
		E. & O.E.

ELECTRICITY TARIFF SCHEDULE w.e.f 01.04.2021							
LT I (B)	Energy Charges (₹ /kwh)	RA Charges (₹ /kwh)	CSS Charges (₹ /kwh)	Wheeling Charges (₹ /kwh)	Fixed/ Demand Charges(₹)	ED %	TOSE (₹ /kwh)
000-100 Units	1.75	0.00	0.16	1.46	140	16.00	0.2604
101-300 Units	4.30	0.00	0.16	1.46	140	16.00	0.2604
301-500 Units	7.75	0.00	0.16	1.46	140	16.00	0.2604
Above 500	8.45	0.00	0.16	1.46	140	16.00	0.2604

1) Residential (3 Phase) - Add. Fixed charges of 140/10 kW or part thereof above 10kW shall be payable. 2) Electricity Duty as per G.O.M Notification No. ELD 2016/CR 252/ENERGY-1 of 31.10.16. 3) Tax on Sale of electricity as per G.O.M Notification No. VVK-2018/CR-161/Energy-1 of 26-12-18.

Sanctioned load (kW) : 8.00
Connected Load (kW) : 8.00
Last Bill amt. : Rs.1,935.00
Last payment received : Rs.1,919.00
Payment received on : 09.09.2021
Payment received mode : UPI

Difference between Billed & Metered units is due to wheeling loss of AEML Network (LT:6.43% & HT: 1.59%).  
FAC : 0\*0.0000

For making bill payment through cheque, please ensure to submit cheque two working days in advance, so that payment will be realized on discount/ due date. Cash Payment can be accepted limited to 5,000/-

**CONSUMPTION PATTERN: UNITS - KWH**

Month	Total Metered Units	Total Billed Units
SEP 2021	277	296
AUG 2021	345	369
JUL 2021	324	346
JUN 2021	468	500
MAY 2021	394	421
APR 2021	307	328
MAR 2021	227	243
FEB 2021	235	251
JAN 2021	256	274
DEC 2020	298	318
NOV 2020	369	394
OCT 2020	332	355
SEP 2020	340	363
AUG 2020	329	352
JUL 2020	409	437

Bill is printed on 100% recycled paper.

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Semester: I

Academic Year: 2021-22

## 5. How you can reduce electrical energy consumption of your home? Alternative's methods.

**Ans.** Here are 11 ways to start conserving energy yourself:

1. Replace your light bulbs By CFL Or LED, They Use Much Less Power and Provide Better Luminosity.
2. Install Automatic Light Sensors or Timed Sensors on Outdoor Lighting. Make Your Refrigerator More Efficient: Setting Your Refrigerator's Temperature Controls to As Close To 37 Degrees to Reduce the Energy.
3. Unplug Electronic Devices When Not in Use.
4. Buy 5-Star Energy Rated Appliances, They Might Be Costly but Use A Lot Less Energy As Compared To Its Lower Rated Counterparts.
5. Use Cold Water While Taking Showers.
6. Install Energy Efficient Windows.
7. Add Insulation to Hot Water Lines & The Water Heater.
8. Install Solar-Powered Landscape Lighting.
9. Install A Programmable Thermostat to Save Energy.
10. Use Low-Flow Faucets And Showerheads.
11. Install Solar panels and solar devices to utilize solar energy.

## 6. Estimation of electrical energy consumption after alternate methods suggested in step-5.

**DECEMBER-21**

Sr. No.	Appliances	Power Rating (watts/appliance) (a)	No of appliances (b)	Utilization in Hours per day (c)	Energy in Wh/1000 (units)/day (d=axbxc)/1000	Energy units/month dx30
1	Lights	7	10	5	0.35	10.5
		5	5	5	0.125	3.75
2	Fans	20	4	20	1.6	48

3	AC	950	1	1	0.95	28.5
4	Washing Machine	950	1	1	0.95	28.5
5	Electric water heaters (Geysers)	400	1	1	0.4	12
6	Monitor	25	1	4	0.1	3.0
7	Phones	10	4	5	0.2	6.0
8	Television	85	1	2	0.17	5.1
9	Refrigerator	150	1	24	3.6	108
10	Laptop	25	1	5	0.125	3.75
<b>Total energy (Units/month)</b>						<b>257.1</b>

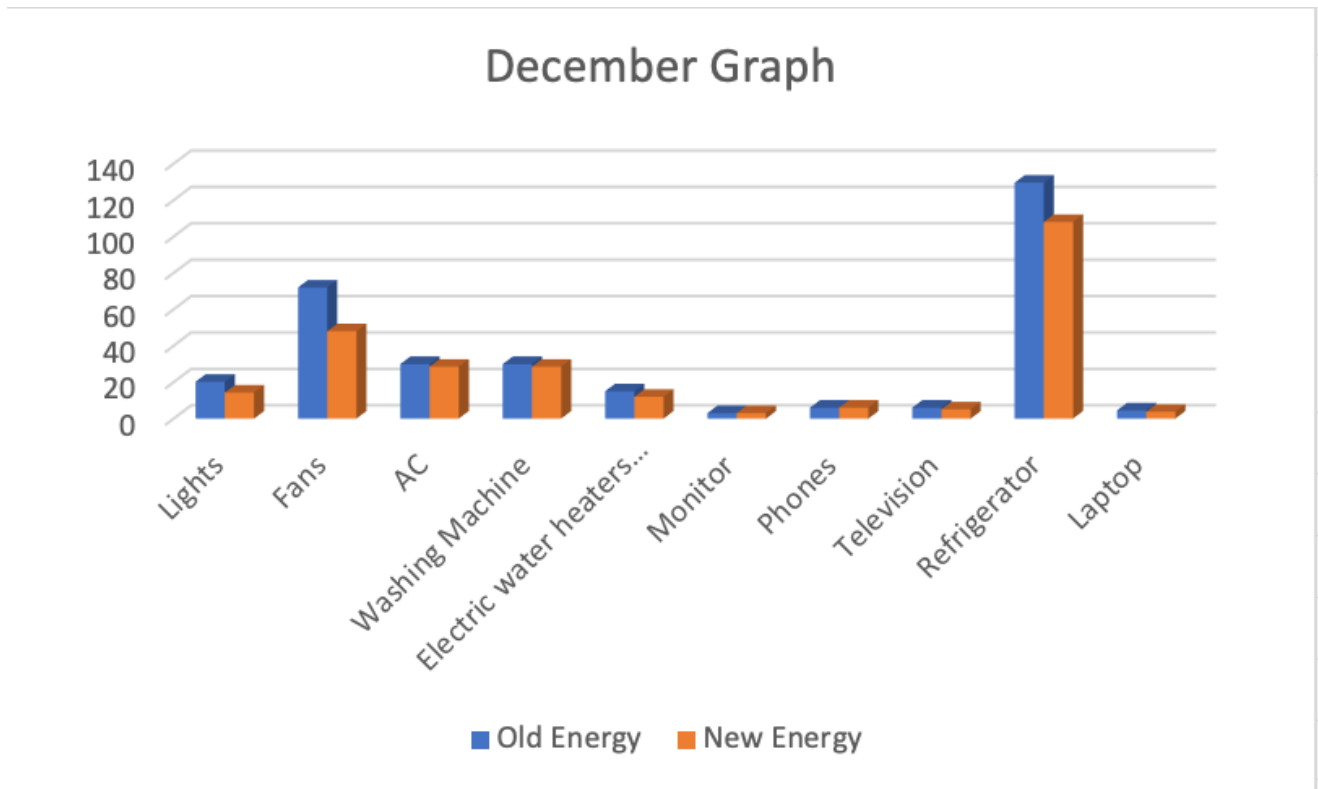
**JANUARY-2022**

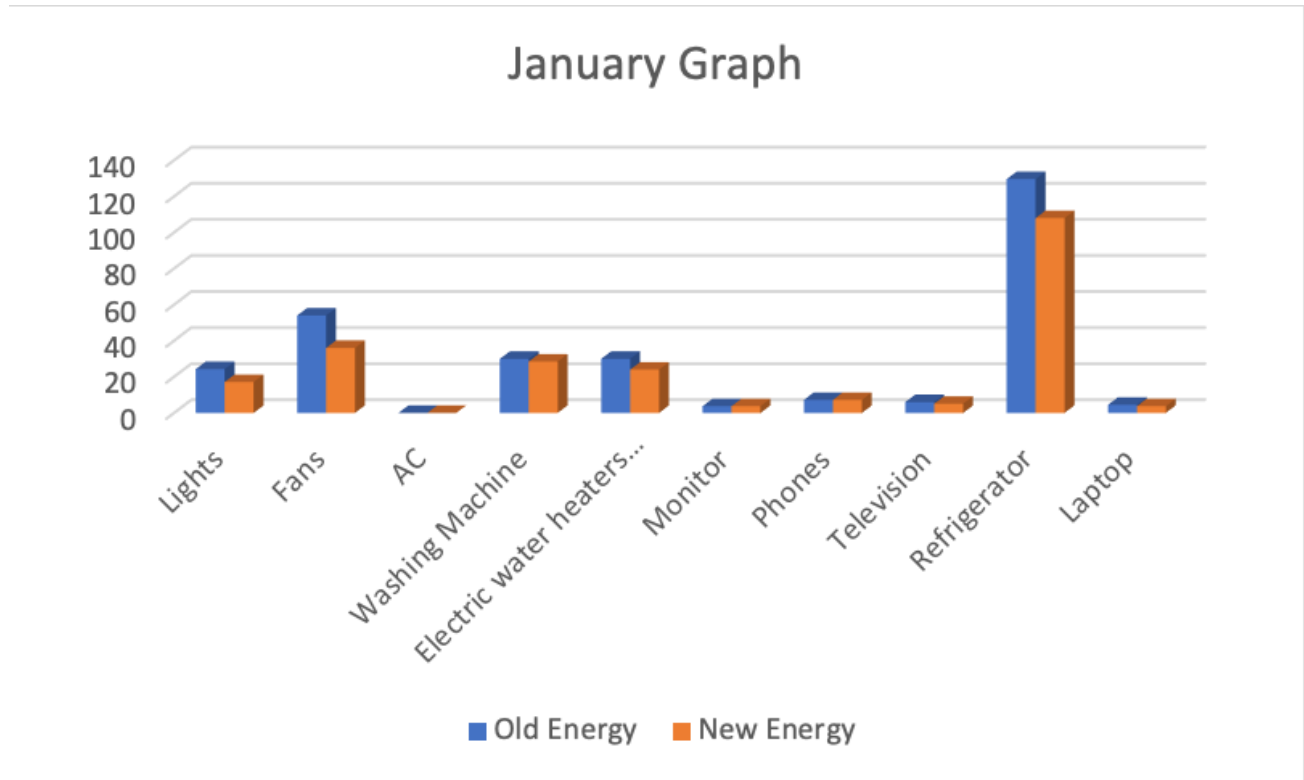
Sr. No.	Appliances	Power Rating (watts/appliance) (a)	No of appliances (b)	Utilization in Hours per day (c)	Energy in Wh/1000 (units)/day (d=axbxc)/1000	Energy units/month dx30
1	Lights	7 5	10 5	6 6	0.42 0.15	12.6 4.5
2	Fans	20	4	15	1.2	36
3	AC	950	1	0	0	0
4	Washing Machine	950	1	1	0.95	28.5
5	Electric water heaters (Geysers)	400	1	2	0.8	24
6	Monitor	25	1	5	0.125	3.75
7	Phones	10	4	6	0.24	7.2



8	Television	85	1	2	0.17	5.1
9	Refrigerator	150	1	24	3.6	108
10	Laptop	25	1	5	0.125	3.75
<b>Total energy (Units/month)</b>						<b>233.4</b>

Plot the bar graph showing the comparison of consumption of December-2021 & January-2022 with alternate methods suggested





**7. Energy saving units/month and expenses in Rs/month (after implementation of alternative method suggested in steps 5 & 6)**

**Ans.**

**For December: -**

Energy consumption	Energy units/month	Total (Rs)
Estimated	316.35	1159
Alternate	257.1	850.10
Actual	314	1143.5

Energy Saved Per Month:  $314 - 257.1 = 56.9$  Units

INR Saved:  $1143.5 - 1159 = \text{Rs } 291.4$



**For January: -**

<b>Energy consumption</b>	<b>Energy units/month</b>	<b>Total (Rs)</b>
Estimated	289.35	987.70
Alternate	233.4	746.90
Actual	301	1042.75

Energy Saved Per Month:  $301 - 233.4 = 11.65$  Units

INR Saved:  $1042.75 - 746.90 = \text{Rs } 295.85$

**Signature of faculty in-charge with Date:**