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| **Course Name:** | **Elements of Electrical and Electronics Engineering** | **Semester:** | **I** |
| **Date of Submission:** | **01/ 02/ 2022** | **Batch No:** | **IT G3** |
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**Internal Assessment: 2**

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

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

**Answer: Electric power** is the rate, per unit time, at which [electrical energy](https://en.wikipedia.org/wiki/Electrical_energy) is transferred by an [electric circuit](https://en.wikipedia.org/wiki/Electric_circuit).

The electric power in [watts](https://en.wikipedia.org/wiki/Watt) produced by an [electric current](https://en.wikipedia.org/wiki/Electric_current) *I* consisting of a [charge](https://en.wikipedia.org/wiki/Electric_charge) of *Q* coulombs every *t* seconds passing through an [electric potential](https://en.wikipedia.org/wiki/Electric_potential) ([voltage](https://en.wikipedia.org/wiki/Voltage)) difference of *V* is

P = work done per unit time = W/T =WQ/QT = VI

{\displaystyle P={\text{work done per unit time}}={\frac {W}{t}}={\frac {W}{Q}}{\frac {Q}{t}}=VI}

where,

Q is electric charge in [coulombs](https://en.wikipedia.org/wiki/Coulomb)

T is time in [seconds](https://en.wikipedia.org/wiki/Second)

I is electric current in [amperes](https://en.wikipedia.org/wiki/Ampere)

V is electric potential or voltage in [volts](https://en.wikipedia.org/wiki/Volt)

The [SI](https://en.wikipedia.org/wiki/SI) unit of [power](https://en.wikipedia.org/wiki/Power_(physics)) is the [watt](https://en.wikipedia.org/wiki/Watt), one [joule](https://en.wikipedia.org/wiki/Joule) per [second](https://en.wikipedia.org/wiki/Second).

Other units of Power are Kilowatt (kW), Megawatt (MW) and Gigawatt (GW).

**Electrical energy** is energy derived as a result of movement of electrically charged particles. When used loosely, electrical energy refers to energy that has been converted from electric potential energy. This energy is supplied by the combination of [electric current](https://en.wikipedia.org/wiki/Electric_current) and [electric potential](https://en.wikipedia.org/wiki/Electric_potential) that is delivered by an [electrical circuit](https://en.wikipedia.org/wiki/Electrical_circuit) (e.g., provided by an [electric power](https://en.wikipedia.org/wiki/Electric_power) utility).

The SI unit of electrical energy is joule (J).

Other units of electrical energy are Kilowatt-hour(kWh) and Electron-Volt(eV).

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

**Answer:** 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 kWh is the amount of energy consumption by 1 kW load in one hour. Therefore, **1 Unit = 1 kWh**.

1 Unit Electricity = 1 kWh

                           = 1 kW x 1 Hour

                           = 1000 W x 3600 seconds

                           = 3.6×106 Joule

1. **Estimate the electricity consumption of your home for two months (units/month)** **December 2021 & January 2022. (Following table is applicable as per actuals)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sr.**  **No.** | **Appliances** | **Power Rating (watts/appliance) (a)** | **No of appliances (b)** | **Utilisation in Hours per day**  **(c)** | **Energy in Wh/1000**  **(units)/day**  **(d=axbxc)/1000** | **Energy units/month dx30** | |
| **1** | **Lights** | 20  15  10 | 5  3  2 | 12  6  2 | 1.2  0.27  0.04 | 36  8.1  1.2 | |
| **2** | **Fans** | 12 | 5 | 18 | 1.08 | 32.4 | |
| **3** | **Air conditioners** | 1000 | 3 | 4 | 12 | 360 | |
| **4** | **Washing**  **Machine** | 500 | 1 | 1 | 0.5 | 15 | |
| **5** | **Electric water heaters**  **(Geysers )** | 3000 | 2 | 0.5 | 3 | 90 | |
| **6** | **Mixer** | 500 | 1 | 0.25 | 0.125 | 3.75 | |
| **7** | **Electric Iron** | 1200 | 3 | 0.25 | 0.9 | 27 | |
| **8** | **Micro-wave Oven** | 2000 | 2 | 0.5 | 2 | | 60 |
| **9** | **Television** | 70 | 1 | 5 | 0.35 | | 10.5 |
| **10** | **Freezer** | 250 | 1 | 2 | 0.5 | | 15 |
| **11** | **Computer** | 80 | 2 | 10 | 1.6 | | 48 |
| **Total energy (Units/month)** | | | | | | | **706.95** |

**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)**

e.g.

120

100

80

60

40

October-19 Energy (Units

/month)

Alternate method Energy (Units /month)

20

0

Lights

Fans

Air

conditioner

…..

1. **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)**

|  |  |  |  |
| --- | --- | --- | --- |
| Energy consumption | Energy  units/month | Billing Rate  Rs./Unit | Total  (Rs) |
| Estimated |  |  |  |
| Actual |  |  |  |

1. **How you can reduce electrical energy consumption of your home? Alternative methods**

**e.g. use of energy efficient lights….. Use of Gas water heater instead of electric water heater… etc.**

**Answer: 1. Switch Off**

TVs, lights, fans, electronics, gadgets and even fixtures like water heaters should be switched off when not in use. Keep the lights on in the room only when needed and unplug electrical devices when not in use. Electrical appliances consume energy even when you are not using them hence plugging something in only when needed can save electrical energy usage in your home. Using a power board which supplies energy to multiple appliances at the same time can be beneficial as it allows you to switch off all devices at once.

**2. Switch to LED**

An easy and simple change you can make is by switching to energy efficient light bulbs such LEDs that help reduce your bills. Incandescent bulbs use heat instead of light to release most of their energy. The modern style bulbs save a lot of electricity and money over time as they are energy efficient. LED bulbs have a longer lifespan and last ten times longer compared to incandescent bulbs. LEDs can be accustomed to your environment as they have dimmable variants and come in multicolor.

**3. Use an Instant water heater**

Switching to the instant water heater is another change you can make to reduce your bills and save energy. These water heaters last longer than traditional tank water heaters which makes them cost efficient in a way. Whenever you store hot water and do not use it, the water cools down, and you have to heat it again. Constant heating of storage water is a waste of money and energy. Instant water heaters deliver hot water on demand and have no storage tank. As no tank has to be kept on to heat the water, instant water heaters have no standby energy loss like traditional tank heaters. Switching to instant water heaters is an excellent option as they reduce energy cost by 25 percent.

**4. Insulate your home well**

Insulating your home right can reduce the amount you will spend on heating and cooling. Most of the modern homes are well insulated. The loss of energy in households occurs mostly through windows. In this case, using double glazing can help retain the indoor heat. Usage of exterior shades or blinds can also help keep the indoors warm and soothing. If the doors are built well, they provide insulation. Also, making sure the doors are closed and windows are closed properly when the AC is on can help save electrical energy of your home./

**5.Go Solar**

Going solar can minimize your power bill and is a massive home efficient upgrade. Solar power is a well-known solution for clean energy that reduces your carbon footprint and saves money. Solar panel systems can generate free power for your systems for 20 plus years but costly to install. Fortunately, there are also affordable ways to save solar power. Also, solar light is an effective means to reduce power consumption.

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr. No. | Appliances | Power Rating (watts) | Utilisation in Hours | Energy in kWh  (units)/day | Energy units/month |
| 1 | CFL/LED lights…. | 20 | 10 | 0.2 | 6 |
| 2 | ---- |  |  |  |  |
| 3 | --- |  |  |  |  |
| 4 | ----- |  |  |  |  |
| 5 | …. |  |  |  |  |
| .  .. |  |  |  |  |  |
| Total energy (units/month) | | | | |  |

Plot the bar graph showing the comparison of consumption of October-2019 with alternate methods suggested e.g.

120

100

80

60

40

October-19 Energy (Units

/month)

Alternate method Energy (Units /month)

20

0

Lights

Fans

Air

conditioner

…..

1. Energy saving units/month and expenses in Rs/month (after implementation of alternative method suggested in step

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