

How Systems Get Energy?

(Week 2, Studio 2)

Time	Duration (mins)	Activity
0:00	10	Studio Briefing
0:10	30	Activity 1: Laptop Selection
0:40	50	Activity 2: Battery Design and Sizing
1:30	30	Activity 3: Case Study
2:00	10	Questions or Doubts. End of Studio

Studio Briefing (10 mins)

The instructor will give a briefing of the studio.

Group size: Individual

Objectives:

- Analyse the needs of different laptop users.
- Translate the needs of individual user into laptop specifications and make apt laptop choices for each user.
- Design a battery pack to meet the requirements of a laptop.
- Calculate the energy requirements of a system as a function of different sub-systems.
- Apply principles of c-rate, depth of discharge and battery parallel-series operation.
- Identify the factors for battery failure.
- Identify safe practices when handling batteries.

Equipment:

- Learning Journal
- Pen or Pencil

Activity 1: Laptop Selection (30 mins)

1. You have joined **CompPE** Services, a laptop consultancy that matches users with their perfect laptop. Each laptop user has specific needs and the ability to analyse and suggest the apt laptop for specific uses has made the company extremely successful.
2. Your first task as an employee of the company is to analyse the needs of the following four customers and suggest the apt processors and graphic card to use for the laptop.

	Customer 1	Customer 2	Customer 3	Customer 4
Customer Profile	Executive, Travels a lot for business	Student	Gamer	Software Programmer
Requirements	Portable, Lightweight, Long Battery Life	Lightweight	Quad Core Processor, Good Graphics Card, Large Screen	16GB RAM, Good Graphics Card
Primary Use	Editing presentations and documents, make conference calls	School work, Social Network, Skype home	Gaming, Overclocking	Coding, Running Test Machines

3. The company has the following processors and graphics cards to choose from

Processors	Intel® Core™ i3-10110Y	Intel® Core™ i5-10210U	AMD Ryzen™ 9 4900HS	Intel® Core™ i5-10600K
CPU Clock	1.0 GHz	1.6 GHz	3.0 GHz	4.1GHz
No of Cores	2	4	8	6
GPU Clock (No dedicated Graphics Memory)	1000 MHz	1100 MHz	1750 MHz	1200 MHz
Power Consumption	5.5W	15W	35W	125W

Graphics Card	GeForce GTX 2080	GeForce GTX 1650	GeForce GTX 2070
Memory	8 GB	4 GB	6GB
GPU Clock	1710 MHz	1590 MHz	1680 MHz
Power Consumption	215 W	75 W	160W

4. Use the company's Secret Procedure as guidelines to identify the different components for each laptop user as below:

- Rule of Thumb 1: Higher Power Consumption → Lower Battery Life.
- Rule of Thumb 2: Lower Power Consumption → Lighter Components → Lighter Laptop
- Rule of Thumb 3: Larger Screen → Larger/Heavier Laptop → Larger Battery
- Rule of Thumb 4: Higher Power Consumption → Faster Laptop
- The Processor and the graphics card consume the largest power in a laptop.
- Rank the following four components on a scale from 1 to 4 based on the primary use and customer requirements for each user

Priority Table for Customer 1/2/3/4

Processor	Weight	Battery Life	Graphics Card

- Choose the Processor and the Graphics card for each user based on the thumb rules and the priority table

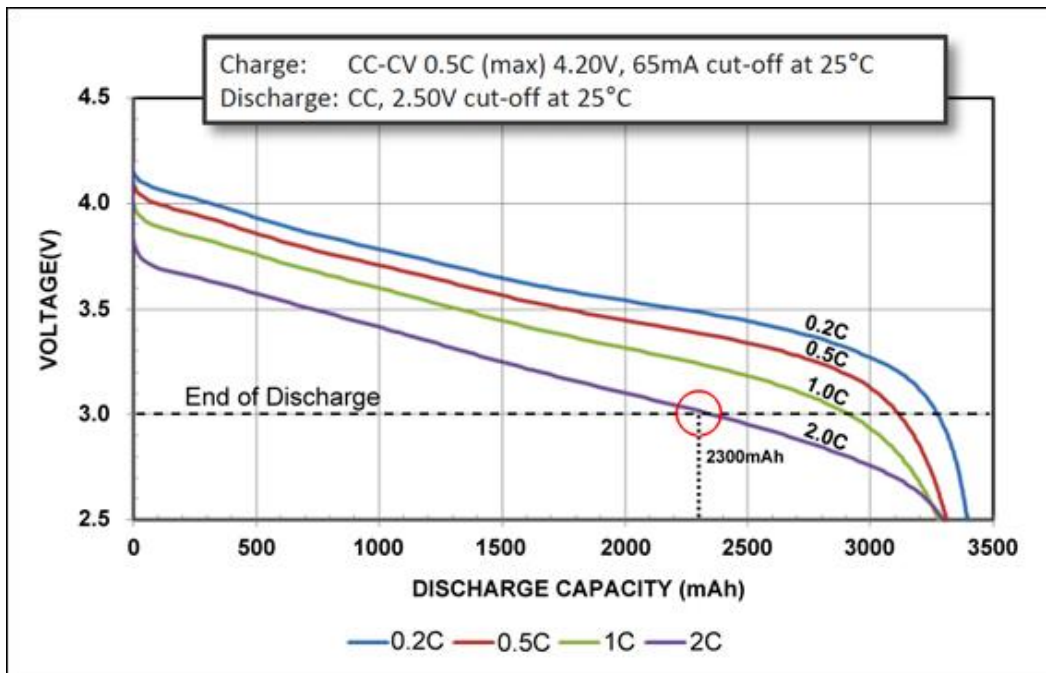
- Calculate the total power consumption of different components in the laptop i.e. Processor, Graphics Card, Hard Disk, RAM etc. All the other components except the processor and the graphics card have a combined power consumption of 15W.
- Use the following table to estimate battery life with respect to the power consumed

Power Consumed	Indicative Battery Life
5W – 15 W	12 Hours
15W – 40W	10 Hours
40W – 95W	8 Hours
95W – 150W	6 Hours
150W – 230W	5 Hours
230W – 300W	4 Hours

5. Make your recommendations (Processor, Graphics Card and Expected Battery Life) for each customer and justify your selection of each component.
6. Note down your observations and findings in your learning journal

Activity 2: Battery Design and Sizing (60 mins)

1. The **student** (Customer 2) now in his second year of undergrad has developed a penchant for gaming and decided to upgrade his laptop battery to facilitate installing a higher end graphics card, more RAM and faster processor.
2. You will help the student design the battery pack for his laptop, to last a period of 5 hours with characteristics shown below and an instantaneous C-Rate of _____. The laptop has the following specifications
 - Operating voltage of **22V** with the following three subsystems working in parallel
 - Graphics Card System : $P_{out1} =$ _____, $\eta_1 =$ _____%
 - Faster Processor: $P_{out2} =$ _____, $\eta_2 =$ _____%
 - Total RAM and Hard Disk System: $P_{out3} =$ _____, $\eta_3 =$ _____%



3. Calculate the Load Capacity, Operating Voltage, the number of batteries connected in series and number of branches in parallel for this battery pack and record them below
 - Load Capacity : _____
 - Operating Voltage : _____
 - Number of Batteries connected in Series : _____
 - Number of Branches connected in Parallel : _____
4. Note down your observations and findings in your learning journal

Activity 3: Case Study- Samsung Note 7

1. In today's case study we will be understanding what went wrong with the Samsung Note 7
2. Let us see the following video (Official Samsung Explanation)
<https://www.youtube.com/watch?v=Sc-hHiGoEpk>
3. Identify the key findings for the Samsung Note 7 explosion.
4. Find other sources or independent reviewers that have validated Samsung's findings
5. What steps has Samsung taken to rectify this problem?
6. Identify safe practices when handling batteries.
7. Note down your observations and findings in your learning journal

Please feel free to ask your GA or the Instructors any questions or doubts you may have.

END OF STUDIO SESSION