Part 1 : Selection of Threshold concept
Transformer fundamentals

What students know : Step up and step down transformer

What they do not know : Exact working principle, three phase transformers, losses and open circuit test and short circuit tests.

Principles :

Principles of Transformer:

1. **Electromagnetic Induction** (Faraday's Law)
2. **Mutual Induction** between primary and secondary windings
3. **Conservation of Energy** (neglecting losses)
4. **Voltage Transformation Ratio** proportional to turns ratio
5. **Current Transformation Ratio** inversely proportional to turns ratio
6. **Magnetic Flux Linkage** through a common core
7. **Operation at Constant Frequency** (for designed performance)
8. **Minimization of Core Losses** (hysteresis and eddy currents)
9. **Minimization of Copper Losses** (I^2R losses in windings)
10. **Operation Based on AC Supply** (not DC, except for special cases)
11. **Magnetic Core Saturation Avoidance** for efficiency
12. **Polarity Considerations** for correct phase relationship
13. **Leakage Flux Minimization** through core design
14. **Impedance Matching** for maximum power transfer

Part 2 : Case Study

Case Study: “The Music Festival Power Puzzle”

Imagine your college is hosting a **huge open-air music festival** with multiple stages, food courts, and giant LED screens.
Electricity is coming from a **distant power plant**. To get the power to the festival site:

1. **The power is sent from far away** in a special way so that less is wasted on the journey.

2. When it reaches the festival, the electricity needs to be **changed again** so the big speakers and stage lights can run safely.

3. There are **three main performance stages** running at the same time, each with different power needs, but all connected in a way that keeps everything balanced.

4. The event managers also want to **check the system before the show** — they do one test when the equipment is connected but **no sound or lights are on**, and another when everything is running at full blast.

5. After the event, they check how much power was **lost as heat or other inefficiencies**, because they want to make it better next time.

Your job is to **advise the festival organizers** on:

- How to set up the system to get electricity from far away **efficiently and safely**
- How to handle the **three big stages** running together without issues
- How and why to do the **two types of pre-event tests**
- How to figure out **where and why energy was lost** during the festival

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Case Study Design in Three Frameworks

1. Bloom’s Taxonomy Approach

Bloom Level	Learning Activity in the Case Study
Remember	Recall what a “changing” device (transformer) does in sending electricity over distance

Understand	Explain why electricity needs to be changed before and after the long journey
Apply	Suggest how the festival can connect three stages so power is balanced
Analyze	Compare the two pre-event tests (no equipment running vs everything running)
Evaluate	Judge which setup would waste less power
Create	Design a safe and efficient power plan for the festival

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2. Fink's Significant Learning Approach

Fink's Dimension	Learning Activity in the Case Study
Foundational Knowledge	Learn the basic role of changing electricity levels
Application	Use the festival scenario to plan safe and efficient connections
Integration	Link knowledge of electricity transfer with event planning
Human Dimension	Understand the role of the event team and engineers
Caring	Appreciate the importance of avoiding power waste for cost and environment
Learning How to Learn	Explore how to read festival power plans and testing results for future projects

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3. SOLO Taxonomy Approach

SOLO Level	Learning Activity in the Case Study
Prestructural	Recognize that electricity is needed for the festival
Unistructural	Identify that electricity must be changed before use
Multistructural	List different stages and testing situations
Relational	Connect the concepts of electricity transfer, balancing stages, and testing

Extended Abstract	Apply the same reasoning to power supply in other large events or cities

Comparison Table: Bloom vs Fink vs SOLO

Feature	Bloom's Taxonomy	Fink's Significant Learning	SOLO Taxonomy
Main Focus	Cognitive skill progression from remembering to creating	Broader dimensions including emotions, human impact, and lifelong learning	Depth of understanding from simple facts to abstract generalization
Structure	Six hierarchical levels	Six interrelated dimensions	Five levels of increasing complexity
Strength	Clear steps for assessing mental skill growth	Connects learning to real-world relevance and values	Shows growth in conceptual depth and integration
Limitation	Focuses mostly on cognitive domain	Less direct about order of learning progression	Not as explicit about emotional or value-based learning
Best Use in This Case	Sequencing the festival problem-solving tasks	Making students see the human and environmental importance of power systems	Helping students build from knowing "we need power" to applying the idea in other big setups

Part 3: Generate the reflection questions for evaluation and write/ map to suitable learning outcomes.

Reflection Questions and Learning Outcome Mapping

Reflection Question	Mapped Learning Outcome
1. During the long journey from the power plant to the festival, why do you think the electricity is "changed" before traveling?	**LO1:** Explain why changing voltage levels helps in efficient power transfer over long distances.

2. What problems might occur if all three stages at the festival took power from the same point without balancing the load?	**LO2:** Describe the importance of distributing electrical loads evenly across multiple systems.
3. The team does a test when nothing is running and another when everything is running. What differences would you expect in the results?	**LO3:** Differentiate between a no-load test and a full-load test and what each reveals.
4. If some energy is lost during the event, where do you think it might have gone, and why?	**LO4:** Identify possible causes of energy losses in a power delivery system.
5. How could the festival team improve their setup next time to reduce waste and improve safety?	**LO5:** Propose improvements to an electrical distribution plan based on efficiency and safety considerations.
6. Imagine a similar large event in another country — how might the solutions you suggested here apply there?	**LO6:** Transfer knowledge of safe and efficient power delivery to different real-world scenarios.