

## Design Thinking and Product Innovation

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Design is a realization of a concept or idea into a configuration, drawing or a product. Design thinking is cognitive and practical processes by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end user. This course introduces the design thinking in product innovation.

### Course Objectives:

- To bring awareness on innovative design and new product development.
- To explain the basics of design thinking.
- To familiarize the role of reverse engineering in product development.
- To train how to identify the needs of society and convert into demand.
- To introduce product planning and product development process.

### UNIT I:

Science to Engineering: Job of engineers, engineering units and measurement, elements of engineering analysis, forces and motion, energy, kinematics and motion, conversion of linear motion to rotary and vice versa, motion transmission.

Physics to Engineering: Application of Newton laws, Pascal's law, Bouncy, Bernoulli's theorem, Ohm's law, and electrical induction in engineering products.

### Learning Outcomes:

After completion of this Unit, the student will be able to

- Relate the principles of science to engineering. (L2)
- Explain simple mechanics motion and force transmission. (L2)
- Identify the laws of physics applied to engineering products. (L3)

### UNIT II:

Historical Development: Invention wheel, early mechanics in design, mechanical advantages, industrial revolution, steam and petrol for mobility. Innovations in Electrical and Electronics: Electrical energy generation, electrical bulb, electrical equipment, electronics and automation, computing for early days to present, innovations in communications.

### Learning Outcomes:

After completion of this Unit, the student will be able to

- Identify innovation in early mechanical designs. (L2)
- Explain development of electrical equipment. (L2)
- List out the developments in computing machines. (L4)
- Summarize innovations in communication systems. (L2)

**UNIT III:**

Systematic approach to product development: Design Thinking, Innovation, Empathize Design Thinking as a systematic approach to Innovation, brainstorming, visual thinking, design challenges, innovation, art of Innovation, strategies for idea generation, creativity, teams for innovation. Solution finding methods: Conventional, intuitive, discursive, methods for combining solution, decision making for new design.

**Learning Outcomes:**

After completion of this Unit, the student will be able to

- Explain the steps in the design process. (L2)
- Apply systematic approach in design. (L3)
- Develop strategies for new product development. (L3)

**UNIT IV:**

Reverse engineering in product development: Reversing engineering methods, identifying the bad features in a product, reduction in size and weight, usage of new materials, 3D printing, and study of introducing electrical and electronic controls to the old products, importance of ergonomics in product development, environmental considerations in design, and safety considerations in design.

**Learning Outcomes:**

After completion of this Unit, the student will be able to

- Understand reverse engineering methods in product development. (L2)
- Use new materials to improve the product. (L2)
- Apply electronic controls to improve the product acceptability. (L3)
- Summarize the safety and environmental factors in new product design. (L2)
- Understand 3D printing in manufacturing. (L2)

**UNIT V:**

Study of Product Development- Agriculture, development of machines for separation of corn seeds, peeling of groundnut shells, husk removing from paddy. Electrical: Design of burglar alarm, speedometer, water level indicator, smart gates, and smart lights. Design of electrical vehicles, unmanned vehicles, design principles in drones.

**Learning Outcomes:**

After completion of this Unit, the student will be able to

- Identify the needs for new product development in agriculture. (L3)
- Develop simple electrical gadgets. (L3)
- Explain the principles in design electrical vehicles and drones. (L2)

**Reference Books:**

1. Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, "Exploring Engineering: An Introduction to Engineering and Design", 4/e, Elsevier, 2016.
2. David Ralzman, "History of Modern Design", 2/e, Laurence King Publishing Ltd., 2010.

3. An AVA Book, "Design Thinking", AVA Publishing, 2010.
4. G. Pahl, W.Beitz, J. Feldhusen, KH Grote, "Engineering Design: A Systematic Approach", 3/e, Springer, 2007.
5. Tom Kelley, Jonathan Littman, "Ten Faces in Innovation", Currency Books, 2006.

**Course Outcomes**

After completion of this course, the student will be able to

- Summarize the importance of basic sciences in product development. (L2)
- Explain the historical developments in mechanical, electrical, communications and computational engineering. (L3)
- Apply systematic approach to innovative designs. (L3)
- Identify new materials and manufacturing methods in design. (L3)