PRODUCT DESIGN AND DEVELOPMENT

(Professional Elective - I)

I Semester

Course Code: 19ME2151

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Course Outcomes: At the end of the course, the student will be able to

CO1: Describe the characteristics used for product design and development.

CO2: Assess the customer requirements in product design.

CO3: Apply structural approach to concept generation, selection and testing.

CO4: Identify various aspects of design such as industrial design, design for manufacture, assembly, service and quality and product architecture.

CO5: Explain various principles and technologies used for the preparation of prototype.

UNIT-I **(10-Lectures)**

Introduction: Characteristics of successful product development, design and development of products, duration, and cost of product development, the challenges of product development.

Development Processes and Organizations: Generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Learning outcomes:

1. Describe the characteristics used for product design and development. (L1)
2. Explain generic product development process. (L2)
3. Explain the AMF product development process and AMF organisation. (L2)

UNIT-II **(10-Lectures)**

Product planning: Product planning process, identify opportunities, evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process Identifying customer needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

Learning outcomes:

1. Describe the steps in product planning process. (L1)
2. Assess the customer requirements in product design. (L5)
3. Analyze the relative importance of customer needs and reflect on the results. (L4)

UNIT-III **(10-Lectures)**

Concept Generation: Activities of concept generation, need for systems level thinking, TRIZ and its comparison with brainstorming and lateral thinking, TRIZ tools – Ideality and IFR, problem formulation and functional analysis, use of 40 principles to solve contradiction, use of S-curves and technology evolution trends.

Concept selection: Overview of methodology, concept screening, and concept scoring, Pugh matrix and its application.

Concept testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process, Failure Mode Effect Analysis (DFMEA and PFMEA).

Learning outcomes:

1. Explain various TRIZ tools and their benefits over other concept generation techniques. (L2)
2. Discuss various concept down-selection tools. (L2)

3. Identify various steps in testing a new concept. (L1)

UNIT-IV **(10-Lectures)**

Product architecture: implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

Industrial design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design.

Design for X (DFX): Design for manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors, design for assembly, service and quality.

Learning outcomes:

1. Analyze various aspects of product architecture. (L4)
2. Explain need for industrial design and identify various aspects of the industrial design. (L2)
3. Explain multiple design attributes of a product: manufacturing cost, quality, assembly. (L2)

UNIT-V **(10-Lectures)**

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes

Product development economics: Elements of economic analysis, base case financial mode, sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Learning outcomes:

1. Explain principles and technologies of prototyping. (L2)
2. Determine various elements of product economic analysis. (L3)
3. Explain qualitative analysis and assess the influence of qualitative factors. (L2)

TEXT BOOKS:

1. A K Chitale and R C Gupta, *Product Design and Manufacturing*, 6th Edition, PHI, New Delhi, 2003.
2. Karl.T.Ulrich and Steven D Eppinger Irwin, *Product Design and Development*, 5th Edition, McGraw-Hill, 2011.

REFERENCE BOOKS:

1. George E Deiter, *Engineering Design*, 5th Edition, McGraw-Hill , 2012 .
2. Boothroyd G, Dewhurst P and Knight W, *Product Design for Manufacture and Assembly*, 2nd Edition, Marcel Dekker, New York, 2002.
3. G Altshuller, H Altov, Lev Shulyak, And *Suddenly the Inventor Appeared: TRIZ, The theory of Inventive Problem Solving*, Technical Innovation Centre, 2nd Edition, May 1996.
4. Vladimir Petrov, *Theory of Inventive Problem Solving, Level 1*, Springer Series, 2019, ISBN: 978-3-030-04253-0.