**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**HYDERABAD CAMPUS**

**FIRST SEMESTER 2021-2022**

**COURSE HANDOUT (PART-II)**

**Date: 11/08/2021**

In addition to Part-I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

# Course Code : DE G531

# Name of the Course : PRODUCT DESIGN

**Instructor-In-Charge : Dr. NITIN KOTKUNDE (Theory)**

**Mr. Aarajoo Jaimin (PhD student, Lab)**

**Description:** Introduction to creative design; user research and requirements analysis, product specifications, Computer Aided Design; standardization, variety reduction, preferred numbers and other techniques; modular design; design economics, cost analysis, cost reduction and value analysis techniques, design for production; human factors in design: anthropometric, ergonomic, psychological, physiological considerations in design decision making; legal factors, engineering ethics and society

# Scope and Objective of the Course:

This course is designed to impart the knowledge required to develop a new product – understand the opportunity, develop and implement a concept. After the successful completion of this course, students shall be able to understand and implement the various processes, tools and techniques required for a product design and development like product specification development; product architecture; concept generation, concept selection, concept testing and embodiment; industrial design; design for X; analytical and numerical models.

# II. Textbook (TB):

1. Kevin Otto and Kristin Wood, “Product Design: Techniques in Reverse Engineering and New Product Development”, 2004, Pearson Education, New Delhi

# III. Reference Books (RB):

1. Karl T. Ulrich and Steven D. Eppinger, “Product Design and Development”, Tata McGraw-Hill Edition, 5th edition, New Delhi, 2016
2. George Dieter, Linda Schmidt, “Engineering Design” Tata McGraw-Hill Edition, 4th edition, New Delhi, 2009
3. David G. Ullman, “The Mechanical Design Process”, McGraw-Hill Inc., Singapore, 1992
4. N. J. M. Roozenburg, J. Eekels, Roozenburg N. F. M., “Product Design: Fundamentals and Methods”, John Wiley and Sons, 1995

**IV. Course Plan (Theory)**

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| **Lecture No.** | **Topic** | **Learning Objectives** | **Source** |
| 1-2 | Journeys in Product Development | Introduction to product design, Modern product development process, Examples of product development processes | TB: Chapter 1 |
| 3-4 | Product Development Process tools | Product development teams, Product development planning | TB: Chapter 2 |
| 5-6 | Scoping Product Developments: Technical and Business Concerns | Determining what to develop, Mission statement, Technical questioning, Business case analysis, Design drivers | TB: Chapter 3 |
| 7-8 | Understanding customer needs | Customer satisfaction, Gathering customer needs, Organizing and prioritizing customer needs | TB: Chapter 4 |
| 9-10 | Establishing product function | Functional decomposition, Simple approach, Black box method, functional modeling | TB: Chapter 5 |
| 11-12 | Benchmarking and establishing engineering specifications | Benchmarking approach, Support tools for benchmarking, Product specifications | TB: Chapter 7 |
| 13-14 | Product architecture | Architecture types, Product modularity, Clustering method, Advanced functional method | TB: Chapter 9 |
| 15-16 | Generating concepts | Concept generation process, Institutive methods, Direct search methods, Morphological analysis | TB: Chapter 10 |
| 17-18 | Concept selection | Concept selection process, Pugh concept selection, Measurement theory, Numerical concept scoring | TB: Chapter 11 |
| 19-20 | Concept Embodiment | Refining geometry and layout, System modelling, Few case studies | TB: Chapter 12 |
| 21-22 | Configuration design | Generating alterative configurations, Best practices for configuration design | RB 2: Chapter 8 |
| 23-24 | Parametric design | Steps for parametric design, Failure Mode Effective Analysis (FMEA) | RB 2: Chapter 8 |
| 25-27 | Design for manufacturing and assembly | Guidelines of design for manufacturing and assembly, Manufacturing cost analysis | TB: Chapter 14 |
| 28-29 | Design for Environment | Design guidelines, Life cycle assessment, Techniques to reduce environmental impact | TB: Chapter 15 |
| 30-31 | Detail Design | Introduction, final design review, Product life cycle management | RB 2: Chapter 9 |
| 32-33 | Material selection | Performance characteristics of materials, Material selection process, Material performance indices, Recycling and material selection. | RB 2: Chapter 11 |
| 34-35 | Industrial Design | Need for industrial design, Industrial design process, assessing the quality of industrial design | RB 1: Chapter 10 |
| 36-37 | Physical Prototypes and Models and Experimentation | Prototype and model basics, Principles of prototyping, Rapid prototyping | TB: Chapter 17 |
| 38-39 | Risk, reliability, safety | Reliability theory, Design for reliability and safety | RB 2: Chapter 14 |
| 40-41 | Quality, Robust design and cost evaluation | Quality control and assurance, design guidelines for robust design | TB: Chapter 19  RB 2: Chapter 15 |
| 42 | Legal and ethical issues in engineering design | Tort law, whistle blowing, ethical behavior of engineers, Product liability | RB 2: Chapter 16 |

# Course Plan (Lab)

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| **Practical No.** | **Experiment Title** |
| 1 | Case study on problem definition and analysis of customer requirements |
| 2 | Case study on defining a mission statement, design parameters and development of House of Quality |
| 3 | Case study on functional decomposition using generic black box method |
| 4 | Implementation of different concept generation techniques for concept development |
| 5 | Concept evaluation and product architecture building |
| 6 | Parametric Design: Material selection, Process selection, Bill of material, Failure modes and effects analysis (FMEA) |
| 7 | Online demonstration on Reverse engineering and 3D printing setup |
| 8 | Introduction to DFA: operational library, DFMA product worksheet/Redesign, Minimum part Criteria, DFA index and case study for DFA |
| 9 | Introduction to DFM: Defining Material, Defining process tree, Selection of machines, order of material, case study for DFM |
| 10 | DFMA: cost estimation vs life volume, Sustainability indicators, case study for DFM+DMA |
| 11 | Life Cycle Assesment: Introduction to SimaPro/OpenLCA, case study by SimaPro |
| 12 | Final lab/project demonstration – Oral Presentations |

Note: All the experimental will be conducted online mode using CREO and Design for Manufacturing & Assembly (DFMA) Software.

# V. Evaluation Scheme and Schedule:

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| --- | --- | --- | --- | --- | --- |
| **EC No.** | **Evaluation Component** | **Duration**  **(min)** | **Weightage (%)** | **Date, Time & Venue** | **Nature of Component** |
| 1. | Mid-semester Exam | 90 | 25 | To be announced by IC    13 / 12 AN | Closed Book |
| 2 | Project Component | - | 15 | Continuous Assessment (Open Book) |
| LAB Component and Case Studies | - | 20 | Continuous Assessment (Open Book) |
| 3 | Comprehensive Exam | 120 | 40 | Partially closed book  (20% - Closed Book, 20% - Open Book) |

**VI. Chamber Consultation Hour:** It will be announced in the class.

**VII. Notices concerning the course:** All notices concerning the course are displayed on CMS only.

**VIII. Make-up Policy:** No makeup for class assessment (surprise quizzes), lab component evaluation. Makeup for Mid semester test, comprehensive examination, project presentations and case study submission will be given for genuine cases with prior permission.

**IX. Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor-In-Charge**

**DE G531**