COEP Technological University

(COEP Tech)

A Unitary Public University of Government of Maharashtra

w.e.f. 21st June 2022

(Formerly College Of Engineering Pune)

ONE YEAR FULL TIME POST GRADUATE DIPLOMA IN INTEGRATED PRODUCT DESIGN AND DEVELOPMENT (PGDIPDD)

Hybrid Mode
(Online-Offline)

Contact details:

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One Year Post Graduate Diploma in Integrated Product Design and Development (PGDIPDD)

[Hybrid Mode]

COURSE STRUCTURE

SEMESTER-1 (16 Weeks)					
Sr. No.	**Title of Course**	**L**	**T**	**P**	**Credits**
1.	Introduction to Design and Innovation	3	-	-	3
2.	Product Communication and Interface Design	3	-	-	3
3.	Collaborative Design Methods for new Product Development	3	1	-	4
4.	Selection of Materials and Manufacturing Processes	3	-	-	3
5.	Introduction to Electronics/ Mechanical (Bridge Course)	3	-	-	3
6.	Computer aided product detailing (rendering/design studio) lab	-	-	2	1
7.	Product design prototyping and advanced manufacturing lab	-	-	4	2
	TOTAL	15	1	6	19

SEMESTER-2 (16 Weeks)					
Sr. No.	**Title of Course**	**L**	**T**	**P**	**Credits**
1.	Design for Usability ad Sustainability	3	-	-	3
2.	Design Management and Professional Practice	3	-	-	3
3.	Design for manufacturing, Assembly and Maintenance	3	1	-	4
4.	Elective-1	3	-	-	3
5.	Form and Aesthetics Lab	-	-	4	2
6.	Product electronics and Instrumentation lab	-	-	4	2
7.	Mini Project-II	-	-	4	2
	TOTAL	12	1	12	19
	Elective -1 1. Vehicle and Transportation Design 2. Agriculture and Farm Product Design 3. Biomedical Device Development				

SEMESTER-3 (16 Weeks)					
Sr. No.	**Title of Course**	**L**	**T**	**P**	**Credits**
1.	Industrial Internship/ complete product design case study	-	-	-	8
2.	MOOCS course on Domain area	-	-	-	4
	TOTAL				12

Introduction to Design and innovation

Teaching Scheme	Examination Scheme
Lectures : 3 hrs/week	100 marks: Continuous evaluation- Assignments
Tutorial : -	MSE - 30 Marks, ISE: 20 Marks, ESE- 50 marks

Course Objectives:

1. To learn need for Innovation and design.
2.To understand Product Study and market study along with difference in product development and product design.
3. To understand importance of Human factors in product design, Physical Ergonomics principles and issues, Ergonomic assessment tool, Cognitive issues in product design.

Syllabus Contents:

Unit 1 **(8 hrs)**

Definition of Product design, Design by evolution, innovation, Essential factors of Product design, Production-Consumption cycle, Flow and Value Addition, Morphology of design (Seven phases), Role of allowances, Process capability, and tolerances in design and assembly, Benchmarking.

Unit 2 **(8 hrs)**

Product strategies (four strategies), Time to market, Product and market, The three S's, (Standardization, Simplification, Specialization), Designer's role, Myth and reality, Design consideration, Problems faced by Industrial designers, Procedure adopted by Industrial designers, Types of models, Role of aesthetics, Functional design practice (Biasing, Cascading, Regeneration, Redundancy, Compatibility, and matching considerations in product design.

Unit 3 **(8 hrs)**

What is value? Nature and measurement of value (Maximum, Normal), Creativity, Step to problem solving and value analysis, Value analysis tests, Idea generation check list, Material and process selection in value engineering (Design, material, process and supplier decisions, product parameters, process selection, material selection, Organizing for material and process selection)

Unit 4 **(8 hrs)**

Anthropometry, design of controls, design for displays, Man/machine interaction, Ergonomic considerations, Workplace layouts, heating and ventilations, lighting considerations.

Unit 5 **(8 hrs)**

Product value, Design for safety, Reliability, and environmental consideration, Economic analysis, Profit and competitiveness, Break even analysis, Economics of new product design

Unit 6 **(4 hrs)**

Concurrent design, Quality function deployment (QFD), Rapid prototyping

Course Outcomes:

At the end of the course, students will:

- Learn basics of product design process and morphology of design.
- Exposed to Concept design, detail design, manufacturing, marketing, Introduction strategy of new product. Students learn about process of design for production of metal components.
- Learn optimization tools and ergonomic principles applied on typical product design as well as concept of value engineering in new product design.

Reference Books:

- - Product Design by Kevin Otto & Kristin Wood, Pearson.
- - Product Design & Development by Karl T. Ulrich.
- - New Product Development byTim Jones & Butterworth Heinmann Oxford.
- - New Product Development: Design & Analysis, Roland EngeneY.,Inetoviez John Wiley and Sons Inc.
- - Product Design for Manufacture and Assembly, Amherst, Geofferry Boothroyd, Peter Dewhurst and Winston Knight.

Product Communication and Interface Design

Teaching Scheme	Examination Scheme
Lectures : 3/week	100 marks: Continuous evaluation- Assignments
Tutorial : -	MSE - 30 Marks, ISE: 20 Marks, ESE- 50 marks

Course Objectives:

1. To understand human capabilities (e.g., visual and auditory perception, memory, mental models, and interface metaphors)
2. To understand Interface technology (e.g., input and output devices, interaction styles, and common interface paradigms)
3. To understand Interface design methods (e.g., user-centered design, prototyping, and design principles and rules), and interface evaluation (e.g., software logging, user observation, benchmarks and experiments)
4. To understand Interaction principles, requirements analysis, designing for different screens (web, TVs and mobile devices), design standards, style guides, techniques and visual design principles

Syllabus Contents:

Unit 1 (9 Lectures)

Introduction

Holistic and integrated approach in developing the various aspects of interface of a product and user – Buying interface, unpacking, installing, regular use, routine maintenance with respect to consumables, standardization of consumable / spares, end of product life.

Explain some historical classical examples of interesting user interface
Considerations while designing the product user interface. Explain with a real life product example

How to design a universal user interface independent of regional languages.
Library of commonly used graphics

Unit 2 (3Lectures)

Human Capabilities

Human sensory elements, Sensers, Actuators.
Limitations of the sensory elements. Chances of human errors. Means of making the interface more robust to avoid human errors in handling the feedback from the products. Explain a field case.

Unit 3 (6 Lectures)
Interface Technology
Various inputs devices, output devices. Interface between input and out devices, interaction styles and common interface paradigms. Demonstrate classical cases about how the interface has evolved for various products over the years. What are the current trends? How it will probably shape the future.

Unit 4 (12 Lectures)
IOT base interface, smart products.
How the interface has evolved with IOT? Benefits to the consumers. Benefits to the business
Consumer goods, Medical equipment, automobile sector, farming equipment
Associated risks to the consumers, risks to the brands, data security – Case study / examples
Legal aspects- Country rules and regulations

Unit 5 (6 Lectures)
Interface Design Methods
User centered design. Design principles and rules, Prototyping Evaluation of interface design (e.g., software logging, user observation, benchmarks and experiments)

Unit 6 (9Lectures)
Interface Design Process
Interaction Principle, Requirement analysis, Designing for different screen like Webs, TVs and mobile devices, design standards, style guides, techniques and visual design principles

Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. How to derive the user interface requirements for the product to be developed
2. Define the user interface requirements for the product to be developed.
3. To understand how to develop the required user interface using support of respective domain experts.
4. Develop smart products using futuristic user interface

Reference Books:

- The Design of Everyday Things by Don Norman
- Mobile Usability by Jakob Nielsen and Raluca Budiu
- The Design of Future ThingsbyDon Norman
- Designing Web Usability: The Practice of Simplicity by Jakob Nielsen

Collaborative Design Methods for New Product Development

Teaching Scheme
Lectures: 3 /week
Tutorial : -1/ Week

Examination Scheme
100 marks: Continuous evaluation- Assignments
MSE - 30 Marks, ISE: 20 Marks, ESE- 50 marks

Course Objectives:

1To learn systematic approach to the Integrated, concurrent design of products and related processes, including manufacturing, product service & support

2. To consider all elements of product life cycle from conception through disposal, including quality, cost schedule & user requirements

3. The objective of Collaborative design is to reduce the system / product development cycle time through a better integration of resources, activities & Processes

Syllabus Contents:

Unit 1 **(6 Lectures)**

What is collaboration?
Necessity of the collaboration.
Type of collaborations. Advantages / benefits. Precautions to be taken in external collaborations. Demonstrate the case studies to understand how the business gets benefit from the collaborations like reduction in system / product development cycle time through better integration of the resources, activities and the process.
How companies can expand market regions and gain from collaborations with partners.

Unit 2 **(6 Lectures)**

Typical functions/departments involved in a real business environment.
Dilemma of each function.
Project team concept, team composition details.
War room / One room concept of project execution.

Unit 3 **(6 Lectures)**

Introduction to Product Development Process – Ideation Phase
Understanding user requirements, various means used to collect the data about Voice of the Customer. Preparing VOC Tree.
Understanding Target group. Focus group discussions. Value Proposition House.

Unit 4 **(6 Lectures)**

Define Phase
Define the user requirements. Use of Quality Function Deployment tool.

Define the technical requirement based upon the user requirements Use a real-life product case for demo. Prepare technical product specifications. List down the functional requirements, performance parameters, compliance standards – Performance & Safety both. Environmental compliance requirements etc.

Unit 5 **(6 Lectures)**

Development Phase

Develop the solution / product to meet the define needs. Development of the detail 3 D cad Preparation of the Bill of material. Selection of materials. Selection of manufacturing process.

Evaluation of the 3D cad using tools like Failure mode and effect analysis. Refinement of the design. Release for prototype making.

Unit 6 **(6 Lectures)**

Prototype testing and evaluation phase

Test and verify the prototype with respect to the product specifications, various compliance requirements. Re conduct Design FMEA, Process FMEA. Check serviceability aspect. Release of the design for tool making.

Unit 7 **(6 Lectures)**

Tools testing and evaluation. Approval of the components. Engineering trial runs. Endurance, life, reliability and other compliance test protocol execution. Execution of the field tests / user tests. Release for mass production

Unit 8 **(3 Lectures)**

Mass production ramp-up. Launch of the product. Post launch evaluation. End of the project.

Assignments – 7 spread over 15 lectures

Reference Books:

- Integrated Product Development byMogens Myrup Andreasen, Lars Hein
- Product Design & Development by Karl T. Ulrich
- Stephen A.R. Scrivener, Collaborative Design: Proceedings o CoDesigning 2000, Springer, 2000
- Routledge International Handbook of Participatory Design *By Jesper Simonsen*, *ToniRobertson*
- David Holston, The Strategic Designer: Tools & Techniques for Managing the Design Process, How Books, 2011

Selection of Materials and Manufacturing processes

Teaching Scheme	Examination Scheme
Lectures : 3 /week	100 marks: Continuous evaluation- Assignments
Tutorial : -	MSE - 30 Marks, ISE: 20 Marks, ESE- 50 marks

Course Objectives:

1To understand role of engineering materials and its applications in product design

2. To learn about smart materials and biocompatible materials

3. To make enable selection of material and appropriate manufacturing process

Syllabus Contents:

Unit 1 (6 Lectures)

Role of materials in product design, Basic Classifications of Materials, Metals and alloys, Ceramics, Polymers, Glasses, composites.

Selection of Materials according to their Mechanical Properties, Selection for static strength, Selection for stiffness, Selection for fatigue resistance, Selection for toughness, Selection for creep and temperature resistance, Selection for corrosion resistance, Selection for wear resistance, Selection for thermal properties, Selection for electrical properties, Selection for magnetic properties, Available forms of materials

Unit 2 (8 Lectures)

Concept of Smart Materials: Retrospective review, main notion, energy aspects of external influence, Materials for electrical engineering and electronics: conductors, semiconductors, dielectrics, magnetic materials, optically active materials, materials for thermoelectric devices, smart battery materials, radio wave absorbing materials, sealing materials, heat-insulating and sound absorbing materials Nanomaterials, its classifications according to size and phase composition criteria, applications of nanomaterials

Unit 3 (6Lectures)

Structure and property relationships of different classes of biomaterials; Interactions of materials with the human body, Classification of Biomaterials, Composite materials and applications, Nanostructured biomaterials, Criteria for selection of biomaterials for specific medical applications. Concepts of biocompatibility, evaluation of biocompatibility, mechanical properties of biomaterials.

Unit 4 (8Lectures)

Classification of manufacturing processes, Sand Casting Processes, Permanent Mould Casting Processes, Hot and cold working of metals, Cutting Machine Tools and Processes, Drilling & Milling Machines, Shaper, Planer and Slotting Machines. 3D printing techniques, soft prototyping methods.

Unit 5 (8 Lectures)

Joining Processes: Welding Processes: Arc Welding –SMAW, GTAW, GMAW, FCAW, Submerged arc welding, etc. Resistance, Spot, Seam, Projection welding processes etc., Gas welding. Thermit Welding, Friction welding, Ultrasonic welding, Electron beam and Laser welding. Soldering and Brazing applications. Use of adhesives for joining.

Abrasive Machining Processes, Types of grinding machines. Honing, Lapping, Super Finishing, Buffing. Surface Treatment Processes: Introduction to super treatment processes. Electroplating, Electroless plating, plasma coating, phosphating, galvanizing, metal spraying, anodizing, rubbing and tumbling.

Unit 6 (6Lectures)

Selection criteria of manufacturing process, process selection for casting, process selection for joining and forming Making a decision for process selection, process selection for surface finish. Manipulative processes for product production, process selection for polymer and ceramic forming, The cost aspects of process selection.

Course outcomes:

1. Students will be able to know about various engineering materials for product development
2. Students will be capable to select appropriate material for product development
3. Students will enable to aware about various frequently used manufacturing processes for product development
4. Students will be capble to select appropriate manufacturing process for product development

Reference Books:

1. S.K. HajraChoudhary and S.K. Bose, “Elements of workshop Technology” Volume I, II, Asia Publishing House, 10th Edition 2000.
2. P.N. Rao, “Manufacturing Technology”, Tata McGraw-Hill Publishing Limited, 2 ndEdition, 2002.
3. V. Raghvan, “Materials Science & Engineering”, PHI 5th Edition, Prentice-Hall of India (P) Ltd
4. John Martins “Materials for Engineers” Maney publishing for The Institute of Materials
5. Raymond A. Higgins, “Materials for Engineers and Technicians”, Fourth edition Elsevier publishing

Introduction to Electronics

Teaching Scheme
Lectures : 3 hrs/week

Tutorial: -

Examination Scheme
100 marks: Continuous evaluation- Assignments
MSE - 30 Marks, ISE: 20 Marks, ESE- 50 marks

Course Objectives:

1To understand role of electronics in product design.

2. To learn about basics of smart electronic system design.

3. To make enable selection of electronic elements for product design.

Syllabus Contents:

Role of various Engineering disciplines in Mechatronics, Mechatronics Design elements, Scope and Applications of Mechatronics, Analog electronic components and devices, Oscillators as signal generators, Power supplies and voltage regulators, Power Electronics- Devices, Industrial electronic circuits, Digital Electronics- Arithmetic circuits, Multiplexers/Demultiplexers, Registers, Counters, Memories, Few examples of transducers, Signal conditioning Circuits using Operational amplifiers, Noise Problems, Grounding and shielding, Data acquisition systems,-Single channel and multichannel, Data loggers, Control Systems Components, Classification of Control Systems, Transfer functions, Time and Frequency response Analysis tools.

Course Outcomes:

At the end of course, student will:

1. Learn how to develop and employ circuit models for elementary electronic components, e.g., resistors, sources, inductors, capacitors, diodes and transistors;
2. Become adept at using various methods of circuit analysis.
3. Use basic techniques for analyzing analogue and digital electronic circuits

References

1. Allen Mottershed, "Electronic Devices and Circuits", Prentice Hall International, Third Edition
2. M. D. Singh and J. G. Joshi, "Mechatronics - Principles and Applications", Prentice Hall India publication-EEE.

Computer Aided Product Detailing (rendering/ Design Studio) lab

Teaching Scheme
Lab : 2 Hours/week
Tutorial : -

Examination Scheme
100 marks: Continuous evaluation- Assignments

Course Objectives:

1. To learn the use of computers as a tool in product design
2. To learn product detailing – A complete product 3D Cad, Geometrical Dimensioning, tolerance analysis.
2. To learn elementary plastic injection molding tool design, sheet metal tool design, die casting tool design
3. Introduction to computer aided Industrial Design

Syllabus Contents:

Unit 1 (4 hrs)
To learn the use of computers as a tool in product design

Unit 2 (8 hrs)
To learn product construction and detailing using 3D cad.

Unit 3 (4hrs)
To learn Geometrical Dimensioning & Tolerance analysis.

Unit 4 (8 hrs)
To learn basics of plastic injection tool design,

Unit 5 (2 hrs)

Sheet metal tool design, Die casting tool design

Unit 6(4 hrs)
To learncomputer aided Industrial Design

Reference Books:

- Injection Mould Design by R.G.W. Pye
- An Introduction to Plastic Injection Molding & Injection Mold Construction by Lee Graham
- Injection Mold Design Engineering by David Kazmer
- Die Casting Dies by Herman
- Die Casting; Dies-Machines-Methods by Lucas Chester L

- Die Design Fundamentals by Paquin,J.R.industrial Press
- Sheet Metal Press Tools Design And Making A Practical Approach by Luqman M
- Press Tool Designs &ConstructionbyP.H.Joshi
- Geometric Dimensioning and Tolerancing by Walter M. Stites, Paul Drake

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. To prepare a complete 3D cad model which complies to the requirements of plastic injection molding, sheet metal press tool and die casting requirements, for the product to be developed
2. Make use of the Geometrical dimensioning in the two dimensional drawings
3. Able to prepare the tolerance analysis
4. Able to prepare an Industrial design using the 3D cad softw

Product Design Prototyping and Advanced Manufacturing Laboratory

TEACHING SCHEME	EXAMINATION SCHEME
Practical: 4 hours/week	**Continuous Evaluations / Termworks :100 Marks**

Course Objectives:

1. To understand CAD Modelling techniques followed in industrial practices.

2. To learn advanced manufacturing techniques in conjunction with CAD techniques.

3. To apply learning to create prototypes.

Course Content:

1. **To study CAD modelling software**: (Autodesk Fusion) to develop 3D CAD models, assemblies, and product drawings (drafting)
2. **Demonstration / performance on polymer extrusion based additive manufacturing Fused Deposition Modelling (FDM):** machine setup, software, design and printing
3. **Demonstration / performance on liquid polymer based additive manufacturing– Stereolithography (SLA)**: machine setup, software, design and printing of components
4. **Demonstration on metal additive manufacturing – Laser Powder Bed Fusion (SLM):** machine setup, software, and printing
5. **Demonstration on Micro Electric Discharge Machining**: hybrid machining demonstration, machining of micro holes
6. **Demonstration on Electro Chemical Machining**: machining setup, machining process for creating micro holes
7. **Demonstration / performanceon advanced visualization and measurement systems**: use of Rapid-I measurement system to analyze machined surfaces and features
8. **Electronics circuits prototype to product**:
    a. Circuit prototyping on breadboard and general-purpose PCB
    b. PCB design using an Electronics CAD software (Autodesk Fusion) and fabrication using photolithography + etching, with a component soldering exercise
9. **Demonstration / performance of Silicon Molding**: Creation of silicon Mold using a pattern created using CNC or SLA, create components by pouring epoxy resin into Molds

Course Outcomes:

Students will learn Product Design Prototyping and Advanced Manufacturing.

SEMESTER – 2

Design for Usability and Sustainability

Teaching Scheme	Examination Scheme
Lectures: 3/week	100 marks: Continuous evaluation- Assignments
Tutorial : -	MSE - 30 Marks, ISE: 20 Marks, ESE- 50 marks

Course Objectives:

1To understand role of usability and sustainability in product design.

2. To learn about man-machine information exchange, ergonomics, and anthropometry, and its applicability in product design.

3. To learn and apply design for product reliability in real-time applications.

Syllabus Contents:

Unit 1 (8 Lectures)
Introduction, Ergonomics, Anthropometry, Design of controls, design of displays, man-machine information exchange, human factors consideration in product design workplace layout from ergonomic considerations, comfort considerations, noise, heating and ventilation, lighting.

Unit 2 (6 Lectures)
Product and process design integration (concurrent engineering), Introduction, Sequential versus Concurrent Engineering, need, basic principles, design for economic manufacturing.

Unit 3 (6Lectures)
Design for reliability, design for safety, risk assessment, reliability quantification, bath-tub curve, system reliability, quality & reliability, steps in design for reliability, ways to improve reliability by design, robust design.

Unit 4(6 Lectures)
Benchmarking for sustainability, steps, support tools for benchmarking process, trend analysis, and opportunities for re-design, benchmarking the competition, setting product specifications.

Unit 5 (6 Lectures)
Usable Product architectures, types, product modularity, Modular design methods.

Unit 6 (4Lectures)
Concept generations for better usability and sustainability, basic methods, morphological analysis, concept selection.

Course outcomes:

5. Students will be able to know about design for usability and sustainability in product design.
6. Students will be capable to select appropriate concept for product development.
7. Students will enable to aware about ergonomic considerations for product development
8. Students will be able to understand reliability aspect for product development.

Reference Books:

1. Product Design and Manufacturing, A.K.Chitale&R.C.Gupta, PHI.
2. Fundamentals of Design and Manufacturing, Pravin Kumar & M. Ramaswamy, Katson books
3. Industrial Engineering & Management, O.P.Khanna , Dhanpat Rai publication
4. Industrial Engineering And Production Management, Martand Telsang, S.Chand

Design Management and Professional Practices

Teaching Scheme	Examination Scheme:
Lectures: 3 / week	MSE: 30 Marks, ESE: 50 Marks, Quiz 20 Marks

Course Objectives:

1. Understand the fundamentals of design management and its application in various industries.
2. Develop strategies for managing design teams and fostering collaboration.
3. Apply project management tools and techniques to design projects.
4. Understand professional practices, including contracts, negotiations, and client management.

Syllabus Contents:

- **Unit 1: Introduction to Design Management:** Design Management, Role of Design in Business Strategy , Case Studies: Successful Design-Driven Companies Starting a Design Business, Funding and Scaling Creative Ventures, Pitching Ideas to Stakeholders (**8 Hours)**
- **Unit 2: Leadership in Design:** Leading Creative Teams, Building a Collaborative Culture, Conflict Resolution and Decision-Making **(6 Hours)**
- **Unit 3: Project Management for Designers**: Tools and Techniques (Agile, Waterfall, Kanban, etc.), Resource Allocation and Budgeting, Timeline Management and Milestones **(6 Hours)**
- **Unit 4: Intellectual Property and Ethics**: Copyright, Trademark, and Patent Basics, Ethical Considerations in Design, Sustainable and Inclusive Design Practices **(4 Hours)**
- **Unit 5 : Professional Practices**: Contracts and Agreements, Negotiation Techniques, Managing Client Relationships (**2 Hours)**
- **Tendering**: Tender types and the process of calling, security and selection system, Office organizations and management, expense, structure of, salaries and overheads, Role of design staff and supporting staff, Personal management and training responsibilities. **(4 Hours)**
- Work and scale of professional charges, mode of working and payments: Code of

professional conduct, Condition of engagement and scale of professional fees, Copyright Act as applicable to Design work,**(4 Hours)**

- **Unit 6: Industry Trends and Future of Design**: Emerging Technologies (AI, AR/VR, etc.) , Case studies on application of AI in design, Global Design Practices, Preparing for the Future of Work **(6 Hours)**

Course Outcomes (COs)

By the end of this course, students will be able to:

1. Demonstrate an understanding of design management principles.
2. Apply project management tools and techniques to design projects.
3. Manage design teams and foster collaboration.
4. Analyze emerging trends and prepare for future challenges.

Reference Books:

1. Design Management: Managing Design Strategy, Process, and Implementation by Kathryn Best
2. Design Thinking by Nigel Cross
3. Karl Ulrich, Steven Eppinger, Product Design and Development, McGraw Hill India.
4. Seider, Seader, Lewin, Widagdo, Product and Process Design Principles: Synthesis, Analysis and Evaluation, 3ed, ISV: Synthesis, Analysis and Evaluation - ISV
5. Daniel Ling, Complete Design Thinking Guide for Successful Professionals, Kindle Edition.

Design for manufacturing, Assembly and Maintenance (DFMAM)

Teaching Scheme	Examination Scheme
Lectures : 3 hrs/week	100 marks: Continuous evaluation- Assignments
Tutorial : - 1 hr/week	MSE - 30 Marks, ISE: 20 Marks, ESE- 60 marks

Course Objectives:

1. To learn need for design for manufacturability.
2. To understand influence of manufacturing processes on product design.
3. To learn product design for assembly and automation
4. To understand importance of Human factors in product design, Physical Ergonomics principles and issues, Ergonomic assessment tool, Cognitive issues in product design.

Syllabus Contents:

Unit 1 **(8 hrs)**

Introduction to Product Design for Manufacturing and Assembly (PDFMA): Working of DFMA, Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design, Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

Unit 2 **(8 hrs)**

High speed Automatic Assembly and Robot Assembly: Design of Parts for High-Speed Feeding and Orienting, Additional Feeding Difficulties, High-Speed Automatic Insertion, General Rules for Product Design for Automation, Design of Parts for Feeding and Orienting, Product Design for Robot Assembly.

Design for Machining and Injection Molding: Machining Using Single-Point and Multi point cutting tools, Choice of Work Material, Shape of Work Material, Machining Basic Component Shapes, Cost Estimating for Machined Components, Injection Molding Materials, The Molding Cycle, Injection Molding Systems, Molding Machine Size, Molding Cycle Time, Estimation of the Optimum Number of Cavities, Design Guidelines.

Unit 3 **(7 hrs)**

Design for Sheet Metal working and Die Casting: Dedicated Dies and Press-working, Press Selection, Turret Press working, Press Brake Operations, Design Rules, The Die Casting Cycle, Auxiliary Equipment for Automation, Determination of the Optimum Number of Cavities, Determination of Appropriate Machine Size, Die Casting Cycle Time Estimation, Die Cost Estimation, Design Principles.

Unit 4 **(7 hrs)**

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.

Reference Books:

1. Geoffrey Boothroyd, Assembly Automation and Product Design, Marcel Dekker Inc., NY, 3rd Edition,2010.
2. Geoffrey Boothroyd, Hand Book of Product Design, Marcel Dekker Inc., NY, 1992.

Course Outcomes:

At the end of the course, students will:

- Learn how to modify or develop product design for ease of manufacture, considering advantages and limitations of various manufacturing processes.
- Students can identify difficulties in manual and automated assembly of product and make changes in product design so as to minimize assembly difficulties by making the product design assembly friendly.
- Exposed to strengths and weaknesses of various metal manufacturing processes so as to modify the product design and make necessary changes for suitable process.

ELECTIVE 1

Vehicle ad transportation Design

Teaching Scheme	Examination Scheme
Labs: 3 hrs/week	100 marks: Continuous evaluation- Assignments

Course Objectives:

1. To prioritize early development of essential automobile design skills through project-based learning
2. To explore Form hands-on approach covers clay modeling, sketching, digital rendering, and prototyping techniques
3. To understand Vehicle Interior and exterior deign.

Syllabus Contents:

Areas of Specialization:

- Vehicle Exterior Design
- Vehicle Interior Design
- Digital Sculpting
- Color & Trim
- Human Machine Interface for Vehicle
- Vehicle Accessory Design
- Automotive Clay Sculpting

Course Outcomes:

At the end of course:

1) Student will learn vehicle interior and exterior design detailing.

Form and Aesthetic lab

Teaching Scheme
Labs: 4 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments

Course Objectives:

1. To learnForm Studies.
2. To explore Form Transition and Techno-Aesthetic Detailing.
3. To understand Elements of Form, Space, Structure & Geometry.

Syllabus Contents:

Aesthetics

Now that you've identified what concept you want to explore, this module will explore the aesthetics of design so that you can refine your prototypes to be as aesthetically pleasing as possible. You'll learn how aesthetics are used in design, and how they motivate reactions toward artifacts overall using a real-world example. You'll also learn how you can apply these aesthetic principles to your own prototype, so that you can make your prototype more appealing and pleasing to potential customers. By the end of this module, you'll be prepared to implement aesthetic changes to your existing prototype so that you can be ready to submit your final design project for review in the following module.

Building the product character and form aligned to product deliverables

At least SIX Assignments based on

1) Form Studies - Radii Manipulation
2) Form Studies: Form Transition
3) Techno-Aesthetic Detailing
4) Color, Material, Finish and Trend Studies
5) Digital Rendering
6) Design Drawing 1 : Freehand, Analytical & Perspective
7) Fundamentals of Design 3: Elements of Form, Space, Structure & Geometry
8) Digital Methods 1 : Photoshop / Illustrator
9) Form Studies 2D/3D

Softwares:

- **Adobe Suite/Rhino/SolidWorks/Keyshots**

Course Outcomes:

At the end of the course, students will:

- Able to design various forms
- Able to apply principles of aesthetics
- Able to render product to the required forms and shape with aesthetic appeal

Product Electronics and Instrumentation Lab

Teaching Scheme	Examination Scheme
Lectures/Practicals :4hrs/week	100 marks: Continuous evaluation-
Tutorial :- -	Assignments- 20 Marks, MSE-30 Marks, ESE- 50 marks

Course Objectives:

1. To provide hands-on experience in designing and implementing electronic systems for product development.
2. To familiarize students with Arduino and ESP32 microcontrollers for instrumentation and control applications.
3. To develop skills in interfacing sensors, actuators, and communication modules with microcontrollers.
4. To understand the principles of data acquisition, signal conditioning, and instrumentation.
5. To enable students to design and prototype electronic products with embedded systems.

Syllabus Contents:

Unit 1 Introduction to Product Electronics and Instrumentation (4hrs)

Overview of product electronics and its applications. Introduction to microcontrollers: Arduino and ESP32. Basics of sensors, actuators, and signal conditioning. Overview of communication protocols: UART, I2C, SPI, and Wi-Fi. Lab safety and equipment handling.

Unit 2 Arduino-Based Instrumentation (8hrs)

Introduction to Arduino IDE and programming. Interfacing basic components: LEDs, buttons, and potentiometers. Analog and digital signal processing using Arduino.

Unit 3 SensorsInterfacing andData Acquistion (4hrs)

Interfacing temperature, humidity, and light sensors with Arduino. Signal conditioning and calibration of sensor data.

Unit 4 ESP32-Based Wireless Instrumentation (8hrs)

Introduction to ESP32 and its features. Wi-Fi and Bluetooth communication using ESP32.

Unit 5 Actuator Control and Automation (4hrs)

Interfacing relays, motors, and servos with Arduino and ESP32. PWM-based speed control of DC motors.

Unit 6 Project Development and Prototyping (4hrs)

Design and development of a mini-project integrating sensors, actuators, and communication modules. Prototyping and testing of the product. Documentation and presentation of the project.

List of Practicals:

1. Blinking LED and Reading Digital Input (Arduino)

2. Reading Analog Signals from a Potentiometer (Arduino)
3. Interfacing DHT11/DHT22 Sensor for Temperature and Humidity Measurement (Arduino)
4. Interfacing LDR for Light Intensity Measurement (Arduino)
5. Interfacing Ultrasonic Sensor for Distance Measurement (Arduino)
6. Setting Up Wi-Fi Communication with ESP32 (ESP32)
7. Sending Sensor Data to a Cloud Platform (ESP32)
8. Controlling an LED Remotely Using ESP32 and Mobile App (ESP32)
9. Controlling a Servo Motor Using Arduino (Arduino)

Reference Books:

- "Principles of Electronic Instrumentation" by A. James Diefenderfer and Brian E. Holton
- "Product Design and Development" by Karl T. Ulrich and Steven D. Eppinger
- "Prototype to Product: A Practical Guide for Getting to Market" by Alan Cohen

Course Outcomes:

At the end of the course, students will:

- Gain aunderstanding about product development processand requirements.
- Innovate and encourage creativity and real-world problem-solving.

Mini Project-II

The mini project will consist of Design, Simulation and Prototype fabrication (DSP) of any device/ Product which can attempt to address technological solution to the existing problems based on the societal and/or research needs, identified in consultation with faculty mentor/supervisor. Students are expected to carry out feasibility study on the concept finalized. The expected prototype must consist of design of the system using any one of CAD tools, simulation/analysis of predicted behavior / expected outcome and fabrication of functional prototype utilizing various prototype fabrication techniques, such as 3D printing, digital fabrication processes and conventional metal fabrication. It is desirable that the prototype may consists of the systems, mechanical structure, embedded electronics (control system for motors, sensors etc. or as per application) and programming of control systems.

• Students can take up individual project or shall form a group of max. 2 students.

• Students should do survey and identify needs, which shall be converted into problem statement in consultation with faculty guide.

• Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.

• A logbook to be prepared by individual or each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.

• Faculty guide may give inputs during mini project activity; however, focus shall be on self learning.

• Students shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide.

• Students shall convert best solution into functional prototype which includes design, simulation and prototype fabrication using 3D printing, digital fabrication processes and conventional metal fabrication.

• The solution to be validated with proper justification and report to be compiled in standard format decided by the department.

• The progress of Mini-Project to be evaluated on continuous basis. Minimum one reviews in each semester. Final examination based on project will be carried out by expert examiner along with faculty guide.

Course Outcomes:

At the end of the course, students will:

1. Learn basics of concept to prototyping in product design.

SEMESTER-3 (16 Weeks)					
Sr. No.	**Title of Course**	**L**	**T**	**P**	**Credits**
1.	Industrial Internship/ complete product design case study	-	-	-	8
2.	MOOCS course on Domain area	-	-	-	4
	TOTAL				12

Industrial Internship/ complete product design case study

The Internship project will consist of Design, Simulation and Prototype fabrication (DSP) of any device/ Product which can attempt to address technological solution to the existing problems based on the societal and/or research needs, identified in consultation with faculty mentor/supervisor. Students are expected to carry out feasibility study on the concept finalized. The expected prototype must consist of design of the system using any one of CAD tools, simulation/analysis of predicted behavior / expected outcome and fabrication of functional prototype utilizing various prototype fabrication techniques, such as 3D printing, digital fabrication processes and conventional metal fabrication. It is desirable that the prototype may consists of the systems, mechanical structure, embedded electronics (control system for motors, sensors etc. or as per application) and programming of control systems.

• Students has to take up individual project.

• Students should do survey and identify needs, which shall be converted into problem statement in consultation with faculty guide.

• Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.

• A logbook to be prepared by individual, wherein he/she can record weekly work progress, guide/supervisor can verify and record notes/comments.

• Faculty guide may give inputs during mini project activity; however, focus shall be on self learning.

• Students shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide.

• Students shall convert best solution into functional prototype which includes design, simulation and prototype fabrication using 3D printing, digital fabrication processes and conventional metal fabrication.

• The solution to be validated with proper justification and report to be compiled in standard format decided by the department.

• The progress of Internship to be evaluated on continuous basis. Minimum one reviews in each semester. Final examination based on project will be carried out by expert examiner along with faculty guide.

Course Outcomes:

At the end of the course, students will:

1. Learn concept to prototyping in depth related to product design domain.

MOOCS course on Domain area

Students need to undergo MOOC Courses offered through NTPEL/ SWAYAM, etc. platforms in the domain areas of Product Design and development.