SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE

Post Graduate Diploma in Computer Aided Product Design

under the Faculty of Science and technology

To be implemented from September 2020

(CBCS Pattern)

Syllabus Structure (Revised)

	Code	Title	Credits
Semester I			
Core Compulsory	PGDC101	Foundation Course in Product Design and Development	4
	PGDC102	Solid and Surface Modeling Using CATIA	4
	PGDC103	Aesthetics, Ergonomics and Prototyping	4
	PGDC104	Mini Projects 1 and 2	4
Elective (Any 2 out of 5)	PGDE105	Engineering Graphics	2
	PGDE106	Computer Fundamentals	2
	PGDE107	Systems Engineering	2
	PGDE108	Sensors and Signal Conditioning	2
	PGDE109	Solar Thermal and PV Systems	2
Semester II			
Core Compulsory	PGDC201	Design for Manufacturing, Assembly, Kinematics and Drafting Using CATIA:	4
	PGDC202	Materials Selection, Cost Estimation and Analysis	4
	PGDC203	IPR, Legal and Ethical Issues	4
	PGDC204	Project	4
Elective (Any 2 out of 5)	PGDE205	Design Team Formation and Management	2
	PGDE206	Communication and Soft Skills	2
	PGDE207	Packaging and Transportation Design	2
	PGDE208	Design Case Studies	2
	PGDE209	Service as Product Design	2

Note: The PG diploma is a 2 semester full time course. The student has to complete a minimum of 20 credits per semester and a total of 40 credits.

- Each semester student can earn 16 credits from compulsory papers and 4 credits from Elective papers
- There would be a minimum of 5 elective papers offered, out of which the student has to offer any 2 papers.
- In future more alternative elective papers can be introduced as per industry expectation.
- All the papers comprise of theory, assignment and practical components, flexibly determined the expert faculty as per industry expectation.
- The conduct of course would be through regular lectures, laboratory training, hands on workshops and Expert seminars/webinars

Semester I
Core Compulsory Papers

PGDC101: Foundation Course in Product Design and Development 4 Credits

Definitions-Design, Product, Product Design, Principles of Engineering Design, Principles of Product Design, Difference between Engineering and Product Design, Types of design, Design attributes, Necessity of design, Parameters involved in design and development of a product, Study of common products and Benchmarking, Necessity of benchmarking, Logic and parameters of product design

Roles and responsibilities of a product designer, Process flow within the organization, Product life cycle, Steps in product design process, Need or opportunity identification, Data collection from various resources such as observation, customer interaction, catalogues and magazines, surveys etc., Preparation of questionnaire, Interpretation of data, Ordering the needs, Sorting out product specifications, Concept generation, Establishing functions and related scientific principles, Product architecture, Drawing rough sketches, Determining dimensions, First presentation, Accommodating suggestions

Problem selection and problem solving, Creative thinking, Methods of creative thinking, Barriers in creative thinking, Generation alternatives, Developing constraints, Concept of User Experience (UX), understanding User Interface (UI) design, Interactive design- Building blocks of UX, knowing the target customer, making design feeling good, useful and enjoyable, Developing customer trust and loyalty, understanding business objectives and strategies,

Selection of the optimum solution, Review, Preparation of design report with Drawings in detail, Product Design Case studies, Study of successful and unsuccessful products, Causes of success and failure.

PGDC102: Solid and Surface Modeling Using CATIA 4 Credits

Introduction to CATIA as a CAD software, Concept of Parametric Modeling, Feature Based Modeling, User Interface, Mouse operations, File types and Management, drawing profiles.Sketcher, visualization toolbar, Modeling of machined component, Material Addition and Removal (Pad, Pocket, Shaft, Groove), Sketch and Positioned Sketch, Types of Fillets, Types of Chamfer, Types of Hole, Pattern (Rectangular, Circular, User), Thread/Tap, Datum Features (Plane, Axes, Points),Simple Draft, Frequently used commands for Machined components in CATIA

Advanced Design features: Axis System, Types of draft, Shell, Stiffener, rib slot, Multi section solid, Removed multi section solid, Apply Material, Measure, render, Introduction To Multi body concept: Copy Paste, Paste special, Insert body, Boolean Operations, Transformation (Translation, Mirror, Scaling, Affinity), Negative body concept (Boolean Operations) Advance Features: Parameters, Formula, Relations, Design

Drafting & Detailing: Initial Drafting setting, Sheet Background, Views: orthographic, ISO, Dimensions , Aux, Section, Details, Clipping, Broken, View properties, DATUMS & Tolerance, Annotations: GD & T, Symbols, Note, Leaders, Table, Symbols (Machining, Roughness, Welding, Custom), Modeling of Machined Component (Part Modeling) Drafting,

Surfacing Modeling, Tool bars, Surface Creation (Extrude, Revolve, Sphere, Cylinder), Surface Modification, Trim, Split, Shape Fillet, Close Surface, Thickness, Surfacing: Offset, Fill, Blend, Join, healing, Project-Combine, Adaptive Sweep, Sweep, Multi section Surface

PGDC103: Aesthetics, Ergonomics and Prototyping **4 Credits**

Concepts of Aesthetics, Harmony among different parts of a product, sense of beauty to attract customers, Role of colours in design, Colour relationship and harmony, Colour sensation and signals

Human factor in design, Vision and other senses, Displays and instructions, Workspace dimensions, Human strengths and weaknesses, User friendly design, Ergonomics- secured operation of a product, avoiding misuse and unintended manner, Standards in ergonomic considerations

Inclusive design, Risk assessment, Causes of unreliability, Minimizing failure, Reliability of resources and cost, Design for environment

Concept and need of prototyping, Use of prototyping, Types of prototyping, Planning and making a prototype, Scale, Dimensions and similitude, Physical prototypes, Virtual prototyping, Experimentation, product data management Techniques of prototyping, Rapid Prototyping-3D printing.

PGDC104: Mini Projects 1 and 2 **4 Credits**

The student is expected to complete 2 mini-projects during semester 1 based on the concepts learned in Core Compulsory and Elective papers. He has to develop either soft or physical prototypes or both for these mini-projects. The student has to submit a report based on the activity and will be evaluated on the basis of design detailing, report, demonstration, presentation and viva. Reports of these mini projects along with record of practical training will be used for portfolio building of the student.

Semester I
Elective Papers (Any 2)

PGDE105: Engineering Graphics **2 Credits**

(This paper may preferably offered by students with non-engineering background.Engineering graduates may find this as repetitionfrom their degree curriculum. However, they may opt for this course, if they wish to revise/refresh)

Introduction to 2D and 3D drafting, Evolution of CAD, Importance of CAD, Point, line & plane, Engineering curves, Introduction to conic sections and their significance, various methods to construct the conic sections. Helix for cone and cylinder, rolling curves (Involutes, Cycloid) and Spiral,

Views- Top view, Front view, Side view, Section view, Orthographic Projection, Principle of projections, Introduction to First and Third angle Projection methods, Orthographic projection of point, line, plane, solid and machine elements/parts, Isometric view, Introduction to isometric projection, oblique projection and perspective projection. Drawingof the isometric projection from the given orthographic views, Development of Lateral Surfaces and its industrial applications. Draw the development of lateral surfaces for cut section of cone, pyramid, prism etc, Dimension and tolerance, Drawing symbols, Assemble and part drawing, Material list, Sketching, Pert list and tables

PGDE106: Computer Fundamentals **2 Credits**

(This paper may be offered by students who wish to learn basics and get familiarity with computers and open source CAD tools)

Computer Fundamentals Overview: I/O devices, peripherals, internal/external memory (ROM/RAM), cache memory, processing unit, hardware/software interfaces, Overview of Ms-Office: MS-Word, MS-Excel, MS-PowerPoint, MS-Publisher for product documentation, presentation and product record maintenance

Open Source Software (tools for making reports/presentation): Infogram-for creating infographics, reports and maps. Canva- for creating interesting and attractive power point presentations, resume, flyers, brochures, posters and other advertising material requiring simple graphics design. Vectr-vector graphics editor-used tocreate website design mockups, brand logos, presentations, brochures, posters, Tinkercad- 3D CAD design tool. Generate simple 3D models for better understanding of product design.

PGDE107: Systems Engineering **2 Credits**

Definition of engineering system, System life cycle, Design and integration, System design process- components, defining systems boundaries, interface design, choosing path to integrate functions and operation, functional and operational development, documentation

Feedback and control, physical architecture, modeling and simulation, analysis and synthesis of system, reliability of system, Project management, Concurrent engineering, Case studies.

PGDE108: Sensors and Signal Conditioning **2 Credits**

Sensors Fundamentals: Types of Sensors & Transducers- Temperature, Optical, Gas, Pressure, Infrared and/or based on Human Sensory organs; Classification- Physical, Electrical, Chemical, Mechanical, performance parameters, understanding the sensor specifications for product design, choosing the right sensor/transducer for meeting product design/specifications

Utility of Sensors for Product Design: Overview of market-available products based on sensors, understanding sensor systems used for product design in Industry 4.0, overview of sensing modules, Sensor based Product design & Applications: Product Design using Sensor technology for various applications such as Environmental, Industrial, Agricultural, Biomedical, Smart-vehicles, Scientific, Smartphones, Smart-gadgets, Signal Conditioning: Sensor Signal-Analog Signal Conditioning, Digital Signal Conditioning, Overview of Signal Conditioning Circuit, Analog& Digital Interface

PGDE109: Solar Thermal and PV Systems **2 Credits**

Solar radiation: Properties of sunlight. Absorption by the atmosphere. Calculation of solar irradiance at surfaces.Solar thermal: Thermodynamic description of solar collectors. Optical properties of solar collectors and technologies for fabrication. Solar thermal systems for different applications, installation and commissioning, Storage of solar generated heat. Overview of different applications. District heating with solar thermal components

Solar cells and modules: The function of solar cells from semiconductor physics. Different solar cell technologies and fabrication methods. Concepts for increasing efficiency based on loss analysis. Wavelength sensitivity. Series connection of solar cells to modules. Module function and characteristics. Shading of cells and modules.Solar cell systems: System components and their functions. Calculating output and dimensioning of solar cell systems. Analysis and computer simulation of a solar cell system. Buying and selling heat and electric energy. Grid as well as environmental and socioeconomic aspects of large scale deployment of solar Systems

Semester II
Core Compulsory Papers

PGDC201: Design for Manufacturing, Assembly, Kinematics and Drafting Using CATIA 4 Credits

Common and special purpose manufacturing processes- casting, forging, sheet metal forming, Machining, Metal joining processes- welding, soldering, Necessity of design for manufacturing, Selection of manufacturing process as per quantity, shape, size, quality, residual stresses, heat treatment, Plastics, Role of standardization, dimensioning and tolerencing, Virtual machining, Estimate of manufacturing cost, Bill of materials

Folding and Unfolding Sheet Metal Parts- Unfolding Sheet Metal Parts, Folding Unfolded Parts, Mapping the Geometry, Creating Flat Patterns of Sheet Metal Components, Viewing a Sheet Metal Component in Multiple Windows.Stamping- Creating a Surface Stamp, Bead Stamp, Curve Stamp, Cut out Stamp, Louver Stamp, Bridge Stamp, Flanged Hole Stamp, Circular Stamp, Stiffening Rib Stamp, and Dowel Stamp

Assembly Modeling: Types of Assembly Design, Approaches Creating Bottom-up Assemblies, Inserting Components in a Product File, Moving Individual Components, Applying Constraints, Creating Top-down Assemblies, Creating Base Part in the Top-Down Assembly, Creating Subsequent Components in the Top-Down Assembly, Creating Subassemblies in the Top-Down Assembly, Editing Assemblies

Kinematics: Introduction to Kinematics, Designing a Mechanism, Creating the: Revolute Joint, Prismatic Joint ,Cylindrical Joint ,Screw Joint, Rigid Joint, Spherical, Planar Joint,Point Curve Joint ,Slide Curve Joint , Roll Curve Joint , Point Surface Joint , Universal Joint, CV Joint, Gear Joint ,Rack Joint, Cable Joint. Converting Assembly Constraints into Joints

PGDC202: Materials Selection, Cost Estimation and Analysis 4 Credits

Material selection in design, Criterion for materials selection, Standard Engineering Materials and their properties, Special purpose materials, selection,

Engineering material, Ferrous and non-ferrous material, Alloy steel and properties, Engineering plastics, Heat treatment and plating,

Design optimization, green design and manufacturing, Measures for Quality assurance, Standard parts material size available in market, Process planning, Time estimation

Cost Estimation: Types of costs, Cost analysis and estimating, Weight and material cost calculation, Process cost calculation, Value engineering, Costing.

PGDC203: IPR, Legal and Ethical Issues 4 Credits

Origin and Development of IPR, analyzing and understanding the Interpretation of IP laws, Need for Protecting IP, Acquisition and duration of rights.

Forms of IPR, Copyright, Trademark, Patents, Industrial Designs, Geographical Indications, Trade Secrets, Patenting Process, Reading and interpretation of IPR documents, Patent Enforcement, Infringement, Patent Prosecution

Design Patents, Concept and Origin of Industrial Designs, Subject matter of Design, Exclusion of Designs, Novelty and originality, Rights in Industrial Designs

Qualities of Engineers & Scientists as Expert Witnesses, Engineering Ethics

PGDC204: Project **4 Credits**

The student is expected to complete a major project during semester 2, based on the entire curriculum for demonstrating the skill, capability and concepts learnt. The project work involves steps including the product selection, need analysis, survey, thought process, team building, choice of appropriate design and analysis tools, awareness of IPR and legal issues, design flow, vendor identification, material procurement, manufacturing process, testing and validation, preparation of presentation and promotional literature and prototype demonstration, He has to develop a soft and physical prototype. The student has to submit a report based on the activity and will be evaluated on the basis of design detailing, report, demonstration, presentation and viva. The student portfolio will be highlighting the activity profile, technical documentation based on hands-on laboratory training and achievement reports of the mini-projects and final project.

Semester II
Elective Papers (Any 2)

PGDE205: Design Team Formation and Management **2 Credits**

Necessity and Advantages of design team, Deciding hierarchy, Team building by selection, Team building by recruiting proper human resource, Members of a team, Setting goals, Delegation of authority, Horizontal and vertical flow of information, Maintaining smooth flow of information within the team, Feedback system,

Preparation of templates, Memoranda format, Use of planning and scheduling software, Trust and loyalty, Team dynamics, Maintaining processing speed and time management, Problems and Conflict resolution, Team management, Team health assessment, Concurrent Engineering.

PGDE206: Communication and Soft Skills **2 Credits**

Communication within and outside the organization -Functional language, interactive skills, face-to-face interaction, preparing questionnaire, Preparation of templates for various purposes, customer Interaction ,conducting surveys ,interpretation of data,writing emails for various purposes, arranging and conducting meetings, telephonic conversation

Negotiation skills, Marketing, Advertising, Brand development, Trade fairs and conferences, Start-up, Launching a new product, Forecasting, Preparation of proposals and design reports, Presentation skills, Interview Skills, Project management, Reading a patent, interpretation of legal terms and conditions, Avoiding plagiarism.

PGDE207: Packaging and Transportation Design **2 Credits**

Introduction to packaging design: Importance of packaging, types of packaging depending upon type of transportation, different types of packaging for multiple size and shapes of product, features of a package, case study of different packages, Package Design – Demographics and Psychographics, Typography, Color, Illustration, Graphic Design Basics, Package Design and Marketing Studies, Package Aesthetics, Decoration Aspects, Layout and Feature Selection, Predicting package performance, Role of Structure, Structural Design. UI/UX of packaging, Optimizing Package Design,

Package design & Development Stages – Planning, Concept design, System design, Prototype design, Refinement and Production.Materials and selection- packaging material selection depending upon product, different types of packing materials-plastics and types, glass, paper, eco-friendly materials, metals etc.Cost of development- Economic considerations -Package cost vs. product cost, Environmental Considerations, package Life cycle Assessment, Legal issues, Case studies of Package development process,Recent trends in packaging, Transportation design- necessity of transportation, brief history of transportation system, modes of transportation for goods and humans.

PGDE208: Design Case Studies **2 Credits**

Case study research, documentation & presentation on a minimum of four products, some successful and some failed at the market place. This includessubsystem elements, principles, detailing mechanisms, technical considerations and applications, aspects of usability engineering, Interaction design; layout and controls, instruments, appliances and machines, Graphic design,Selection of materials and processes for manufacture,Batch production and mass production, Health and Product Safety and Liability.

PGDE209:Design for Service as a Product **2 Credits**

Meaning of service in design industry, Necessity of service design, Methodology of service design, Value addition to organization, Characteristics of service, Deciding the nature of service, How to maintain the quality of service, Creating and judging user's perception of service, Service environment, Factors affecting the service

Mechanisms to increase productivity using efficient service, Methodologies to build customer's trust, preparation of a model of service, How to synthesize elements of service, How to implement the service model, Service team, Selection or development of human resource, correlation of service team with various departments in the organization.