# Curriculum M.Des

## Integrated Product Design

(From The Academic Year 2021)

Approved in Senate-44

Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram

Chennai-600 127

# Curriculum & Syllabus

| Semester 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| S.No | Course Code | Course Name | Category | L | T | P | C |
| 1 | DS5000 | Foundation for integrated product design | DSC | 2 | 1 | 0 | 3 |
| 2 | DS5001 | Aesthetics, Forms and Sketching | DSC | 1 | 0 | 3 | 3 |
| 3 | DS5002 | Design, Technology and Society | DSC | 2 | 1 | 0 | 3 |
| 4 | DS5003 | Design Research: Theory and Methods | DSC | 2 | 1 | 0 | 3 |
| 5 | DS5004 | Material selection for product designers | DSC | 2 | 1 | 0 | 3 |
| 6 | DS5005 | Design Realization Skills Practice | DSC | 0 | 0 | 3 | 2 |
| 7 | DS5006 | Visual Communication Design | DSC | 2 | 1 | 0 | 3 |
| 8 | DS5007 | Concept Design Project | PCD | 1 | 0 | 6 | 5 |
| | | | | | | | 25.0 |
| Semester 2 | | | | | | | |
| S.No | Course Code | Course Name | Category | L | T | P | C |
| 1 | DS5008 | Digital Sketching and Modelling | DSC | 1 | 0 | 3 | 3 |
| 2 | DS5009 | Bio-inspired design | DSC | 2 | 1 | 0 | 3 |
| 3 | DS5010 | Design for quality and reliability | DSC | 2 | 1 | 0 | 3 |
| 4 | DS5011 | Interaction design (UX / UI) | DSC | 2 | 1 | 0 | 3 |
| 5 | DS5012 | Human Factors & Ergonomic Design | DSC | 2 | 1 | 0 | 3 |
| 6 | DS5013 | Embodiment Design Project | PCD | 1 | 0 | 6 | 5 |
| 7 | | Elective Course I | ELC | 2 | 1 | 0 | 3 |
| | | | | | | | **23.0** |
| Semester 3 | | | | | | | |
| S.No | Course Code | Course Name | Category | L | T | P | C |
| 1 | DS6000 | Internship | PCD | 0 | 0 | 32 | 16 |
| 2 | DS6002 | Strategic management of design and innovation | DSC | 2 | 1 | 0 | 3 |
| 3 | DS6003 | Sustainable Product Service Systems | DSC | 2 | 1 | 0 | 3 |
| | | | | | | | 22.0 |
| Semester 4 | | | | | | | |
| S.No | Course Code | Course Name | Category | L | T | P | C |
| 1 | DS6004 | Project | PCD | 0 | 0 | 32 | 16 |
| 2 | | Elective Course II | ELC | 2 | 1 | 0 | 3 |
| 3 | | Elective Course III | ELC | 2 | 1 | 0 | 3 |
| | | | | | | | 22.0 |

# Curriculum & Syllabus

Semester wise Credit Distribution

| Category | Semester Wise Credits | | | | | |
|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | Total | % |
| Professional Core Course (PCC) | 0 | 0 | 0 | 0 | 0 | 0 |
| Design Course (DSC) | 20 | 15 | 6 | 0 | 41 | 44.6 |
| Elective Course (ELC) | 0 | 3 | 0 | 6 | 9 | 9.8 |
| Professional Career Development (PCD) | 5 | 5 | 16 | 16 | 42 | 45.6 |
| Total | 25 | 23 | 22 | 22 | 92 | 100 |

# Curriculum & Syllabus

<table>
<tr><td>Course Name</td><td>Foundation for integrated product design</td><td>Course Code</td><td colspan="4">DS5000</td></tr>
<tr><td>Offered by Department</td><td>SIDI</td><td>Structure (LTPC)</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>M.Des</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>NIL</td><td>Approved In</td><td colspan="4">Senate-44</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Unlearn limiting assumptions, risk avoidance, fear of failure<br>• Awaken their senses & rediscover their creative selves<br>• Experience the impact of design and technology in everyday objects<br>• This course is expected to be conducted as part of the induction process (first two weeks)</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end the course, the students are expected to:<br>• unlearn key limiting assumptions<br>• demonstrate qualities of immersion in a task<br>• be excited by the potential of technology and design in improving lives<br>• become comfortable with sketch-thinking and develop skills in design sketching</td></tr>
<tr><td>Contents of the course (With approximate break up of hours)</td><td colspan="6">Module-1: Induction: (16 hrs)<br>• History of the place; the industrial ecosystem; institution<br>• Exercises to improve interaction; local visits;<br>Module-2: Learn to observe nature and self (32 hrs)<br>• Know your context - physical and social;<br>• Unlearning activities; Start journaling<br>• Observe wholes-parts (trees-leaves); variety of leaves; colors<br>• Document in a variety of ways - collage; sketch, paint, photograph, video<br>Module-3: Learn to observe everyday objects (32 hrs)<br>• Unbundle everyday objects, observe, reorganize<br>• Whole-part relations; System physics;<br>• Observe interplay of art, design, culture, technology in everyday objects<br>Module 4: Take ownership for your learning<br>• Understanding learning strategies<br>• Self-reflection & purpose for being</td></tr>
<tr><td>Essential & Supplementary Readings</td><td colspan="6">1. Frank R Wilson (1998), The hand: How it shapes the brain, language and human culture, Vintage Books, NY, ISBN: 9780679740476<br>2. Keri Smith (2008), How to be an Explorer of the World: Portable Life Museum, Penguin Group,<br>ISBN:9780241953884</td></tr>
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# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Aesthetics, Forms and Sketching | Course Code | DS5001 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 1 | 0 | 3 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | • To introduce elements of art and their application in aesthetics and design<br>• To provide in-depth understanding of principles of design, concepts of form, 2D/3D geometries, exploration of surface textures in different materials, relationship between form, materials and process.<br>• To provide hands-on training in sketching to enable the students to communicate the design ideas and also to stimulate design improvements | | | | | |
| Learning Outcomes | At the end of the course the students will be able to:<br>• Understand aesthetic principles governing the design<br>• Use freehand sketching to communicate the design ideas through realistic product representations | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Art-Design-Aesthetics Interrelation (8 hrs)**<br>Role of art in design and idea communication; Aesthetics in design; Drawing tools and materials; Basic sketching; Emotive qualities of line; line wight and style<br><br>**Module 2: 2D and 3D forms (12 hrs)**<br>Geometric and organic shapes; Shape modifications; Basics of forms; Constructing complex forms from solids; Freehand representation of shapes and forms using orthographic drawings<br><br>**Module 3: Spatial thinking and visualization (20 hrs)**<br>Rendering space in 2D paper – basics of perspective; +/- ve space; white space – composition of objects; Concepts of isometric and perspective drawing and sketching of regular shapes; Scale and proportion; Principles of design in sketching – balance, alignment, emphasis, proportion, movement, pattern, contrast, unity; Freehand generation of complex forms and structures; Product sketching, exploded views and cutaway sections; Quality of light on the forms - Value study and value techniques.<br><br>**Module 4: Surface qualities and color (12 hrs)**<br>Representation of surface characteristics and materials through texture; Relating form to materials and processes of manufacture; Color theory and color harmony; Introduction to color psychology and its application in design – case studies.<br><br>*Hands-on practice will focus on presentation of design ideas through sketches using conventional tools.* | | | | | |
| Essential & Supplementary Readings | 1. J.Itten (1975), Design and Form, John Wiley and Sons, ISBN:9780471289302<br>2. Robert H McKin (1980), Experiences in visual thinking, Brooks/Cole, ISBN: 978-0818504112<br>3. D'Arcy Thompson (1992), On growth and form, Cambridge University Press, ISBN:9780521066228<br>4. Shyamala Gupta (1999), Art, beauty and creativity: Indian and Western Aesthetics, D.K.Printworld , ISBN: 9788124601334<br>5. Betty Edwards (2001), The New Drawing on the right side of the brain, Harper Collins, ISBN:9780007116454<br>6. Hannah. G. G (2002), Elements of design: Rowena Reed Kostellow and the structure of visual relationships, Princeton Architectural Press, ISBN:9781568983295<br>7. M. Macnab (2011), Design by nature: Using universal forms and principles in design, New Riders, ISBN:9780321747761<br>8. D. Puhalla (2011), Design elements, form & space: a graphic style manual for understanding structure and design, Rockport Pub, ISBN:9781592537006<br>9. K. Eissen, and S. Roselien (2012), Sketching: basics, Stiebner Verlag GmbH, ISBN:9783830714101 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Design, Technology and Society | Course Code | DS5002 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | • To provide an understanding of the social and cultural history of design and technology<br>• To develop critical thinking skills and ability to surface unstated needs / hidden meanings | | | | | |
| Learning Outcomes | At the end of the course the students will develop<br>• An appreciation of historical development of design and technology<br>• Use sociological perspectives to understand the context of design & navigate the same<br>• Apply ethnographic methods to surface cultural and social aspects for concept development | | | | | |
| Contents of the course (With approximate break up of hours) | **Module-1: History of Design & Technology (9)**<br>• Industrialization, technology and design<br>• Design movements - The Bauhaus, Ulm school of design and Indian design<br>• What is 'Indian' and how it has been defined over time - artifacts, rituals, myths<br>**Module-2: Sociology of Design (12)**<br>• Key sociological perspectives – functionalist, conflict and interactionist<br>• Material / temporal / relational dimensions & Actor Network Theory<br>• What drives creative design teams - Interactionism and Reflexivity<br>**Module-3: Ethnographic observations (21)**<br>• Immersive observation of everyday objects and interactions<br>• Gigamapping/rich pictures to capture observations<br>• Journaling, synthesizing observations<br>• Field visits: Urban/Rural context/needs/problems<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Gyorgy Kepes ed. (1966), Vision + Value series (The man-made object), George Braziller, ISBN:9781122190879<br>2. Papanek, Victor (1985); Design for the Real World: Human Ecology and Social Change, Academy Chicago Publishers; 2nd Revised edition, ISBN:9780897331531<br>3. Vance Packard (2007), The hidden persuaders, Ig Publishing, Reissue edition, ISBN:9780978843106<br>4. Balaram, S. (2010), Thinking Design, Sage India, ISBN:9788132103141<br>5. Trevor Pinch (Editors) (2012), The Social Construction of Technological Systems: New directions in the sociology and history of technology, MIT Press, Anniversary Edition, ISBN:9780262517607<br>6. Wendy Gunn, Ton Otto & Rachel Smith (2013), Design Anthropology: Theory and practice, Bloomsbury, ISBN:9781472518231<br>7. Adrian Forty (1992), Objects of desire: Design and society since 1750s, Thames & Hudson, ISBN:9780500274125<br>8. Bernhard E Burdek (2015), History, theory and practice of product design, second revised edition, ISBN:9783035603965<br>9. Bloomsbury (2015), The Bloomsbury encyclopedia of design, Bloomsbury Academic, ISBN:9781472521576<br>10. Swapnaa Tamhane and Rashmi VarmSar (2016), The Essence of Indian Design, Phaidon Press, ISBN:978071480502 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Design Research: Theory and Methods | Course Code | DS5003 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | • To introduce students to a variety of theories and methods used in new concept development<br>• To enable students to pick and choose appropriate methods for the context | | | | | |
| Learning Outcomes | At the end of the course, students are expected to<br>• Apply a set of methods to inquire into a problem situation and define product requirements<br>• Reflect on the methodological assumptions and strengths and weaknesses of different methods | | | | | |
| Contents of the course (With approximate break up of hours) | **Module-1: Introduction (6 hrs)**<br>• Product development process<br>• Complexity in the fuzzy front-end of new product development<br>• Product ontology (form-function-structure-behaviour)<br>**Module-2: Introduction to design theories and methods of inquiry (6 hrs)**<br>• Developments in design methodology – phenomenology, semiotics, information-aesthetic<br>• Qualitative, quantitative, speculative, experiential modes of research<br>**Module-3: Methods to capture requirements/surface needs (12 hrs)**<br>• Understanding social, economic (competition, value chains) and technology trends<br>• Human/User-centered design theory and methods; Systems theory and methods<br>**Module-4: Methods to synthesize findings and writing design briefs (18 hrs)**<br>• Developing a design brief (problem statement)<br>• Methods of divergent and convergent thinking to ideate concepts<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Dan Norman (2010); Living with complexity, MIT Press, ISBN:9780262014861<br>2. Brenda Laurel (ed.) (2003), Design research: Methods and perspectives, MIT Press, ISBN:9780262122634<br>3. Sanders L & Stappers P J (2013), Convivial Toolbox: Generative research for the front end of design, BIS, ISBN:9789063692841<br>4. Peter Dowtown (2013), Design Research, Elizabeth James Productions, Melbourne<br>5. Bruce Hanington and Bella Martin (2019), Universal methods of design, Rockport Publishers, Rev edn, ISBN:9781631597497<br>6. Edward De Bono (2015), Lateral Thinking: creativity step by step, Harper Perennial, Reissue edition, ISBN:9780060903251<br>7. Annie Gentes (2017), The in-discipline of design, Springer, ISBN:9783319659848<br>8. Toshiharu Taura (2016), Creative design engineering: An interdisciplinary approach, Elsevier, London, ISBN:9780128042267 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Material selection for product designers | Course Code | DS5004 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | • To introduce a range of materials used in different stages of product devp (concept to prototype)<br>• To provide detailed understanding of the behaviours of different classes of materials with respect to temperature stability, thermal and electrical conductivity, strength, toughness and chemical resistance<br>• To introduce analytical tools and methods for qualified materials selection for product design | | | | | |
| Learning Outcomes | After completion of this course, students are able to:<br>• Apply systematic and objective materials selection based on the principles of Ashby model/ Cambridge Engineering Selector (CES)<br>• Define correct conditions and objectives regarding materials selection and analyze and evaluate the role of geometrical aspects in materials selection | | | | | |
| Contents of the course (With approximate break up of hours) | **Module-1: Introduction and overview (18 hrs)**<br>• Properties of Metals, Ceramics and Polymers<br>• Basics of design calculations and design-oriented materials selection,<br>• Introduction to Material Property Charts<br>**Module-2: Material selection process (18 hrs)**<br>• Rationalizing and Critical Assessment of Material Properties<br>• Selecting materials and shape with multiple constraints and objectives<br>• Materials selection for industrial design<br>**Module-3: Advanced materials & environment (6 hrs)**<br>• Advanced materials design – Composites and Hybrids<br>• Materials and environment<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Ashby, M.F. (1992), Materials Selection in Mechanical Design, Elsevier, 5th and 4th editions, ISBN:9780081005996<br>2. Gordon, M. Joseph (2002); Industrial design of plastics products, ISBN:9780471231516<br>3. Karana, Elvin, Owain Pedgley, and Valentina Rognoli, eds. (2013), Materials Experience: fundamentals of materials and design. Butterworth-Heinemann, ISBN:9780080993591<br>4. Maleque, Md Abdul, and Mohd Sapuan Salit (2013); Materials selection and design. Springer Singapore, ISBN:9789814560375 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Design Realization Skills Practice | Course Code | DS5005 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 0 | 0 | 3 | 2 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | To help students develop workshop practice and rapid prototyping skills to realize mock-ups and concept prototypes | | | | | |
| Learning Outcomes | Students will develop skills in workshop practice and rapid prototyping; project management and focusing on delivering outcomes | | | | | |
| Contents of the course (With approximate break up of hours) | **Module-1: Exposure to tools/equipment to machine external appearance of simple shapes. (20 hours)**<br>a. Wood carving<br>b. Plastic welding and cutting<br>c. Engraving<br>d. Sheet metal works<br>e. Wire cutting<br>**Module-2: Exposure to rapid prototyping tools – subtractive, additive and electronic (8 hours)**<br><br>**Module-3: Practice in realizing simple products in terms of shape, size and functionality etc. (14 hours)**<br><br>Evaluation: Assignments / Activities (70%); End Semester (30%) | | | | | |
| Essential & Supplementary Readings | 1. Bjarki Hallgrimsson (2012), Prototyping and Modelmaking for Product Design, Lawrence King Publishing, ISBN:9781856698764 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Visual Communication Design | Course Code | DS5006 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | To introduce students to a practice-based, hands-on approach to visual communication design | | | | | |
| Learning Outcomes | On completion of this course, students will be able to:<br>● Understand differences between visual UX, UI, graphic, and web design and construct an artist's statement<br>● Apply the concepts found within elements and principles of design to incorporate theories and concepts when discussing visual communication,<br>● Create a brand identity such as business cards, packaging, and advertising, design logos, especially as related to brand identity<br>● Use digital tools to design graphical images, understand the difference between different graphics and image file formats. | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Introduction to Visual Communication Design (6 hrs)**<br>● Definition, Graphic design vs art, Design thinking, Visual design tools and Image files<br>● Semiotics and design<br>**Module 2: Typography and typographic elements (6 hrs)**<br>● Historical evolution, Serif vs sans-serif fonts, Legibility vs readability, Use in ads, signs, movie posters<br>**Module 3: Composition, Creativity, Artistry, Aesthetics and the design process (6 hrs)**<br>● Focus, Leading lines, Scale/hierarchy, Contrast, Repetition, White space and Rule of thirds<br>● Creativity vs Innovation, Aesthetics and their evolution, Creative/Design Process and flow<br>**Module 4: Symbolism and collage (12 hrs)**<br>● Symbols and signs, Psychoanalytical symbols, Metaphor in visual design, Evolution of symbols and metaphor<br>● Collage, Photomontage, Assemblage, Digital collage/e-Collage, Influence of movements: Dada, Surrealism, Expressionism<br>**Module 5: Visual identity and branding (12 hrs)**<br>● Visual identity, branding, logo design, UI/UX and design for the web, advertising, brochures, print and posters.<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Umberto Eco (1978), A theory of semiotics, John Wiley & Sons, ISBN:9780253202178<br>2. Edward Tufte (1990), Envisioning information, Graphics Pr, ISBN:9780961392116<br>3. Carolyn Handa (2004), Visual rhetoric in a digital world: A critical sourcebook, Bedford/St Martin's, ISBN:9780312409753<br>4. Lidwen W, Holder K and Butler J (2010), Universal principles of design, Rockport publishers, ISBN:9781592535873<br>5. M. Davis and J. Hunt (2017), Visual Communication Design, Bloomsbury Academic, New Edition, ISBN:9781474221573 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Concept Design Project | Course Code | DS5007 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 1 | 0 | 6 | 5 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | To encourage the students to identify a domain and problem of interest, and conceptualize and showcase a new product concept using all the theories, methods and tools learnt in the 1st semester courses | | | | | |
| Learning Outcomes | At the end of the course, the student is expected to:<br>• gain confidence in dealing with the fuzzy front end of product innovation<br>• gain practical hands-on experience in doing design research, making design choices<br>• conceptualizing and pitching a new product concept to external industry experts | | | | | |
| Contents of the course (With approximate break up of hours) | The concept design project is expected to be done in a team. The team must experience the process of norming, forming and performing<br><br>The process followed will be based on the methods learnt in the Design Research course, supplemented by the content and skills learnt in other courses<br><br>Project management, documentation and presentation skills will be key aspects that will be monitored<br><br>The activity will be carried out in the design studio, and supported by regular design reviews with peers, faculty, and mentors<br><br>Evaluation: Evaluation: 70% Continuous assessment + 30% Final Concept Presentation | | | | | |
| Essential & Supplementary Readings | 1. Dan Cuffaro and Isaac Zaksenberg (2013), The Industrial Design Reference & Specification Book: Everything Industrial Designers Need to Know Every Day, Rockport publishers, ISBN:9781610587891<br>2. Bruce Hanington and Bella Martin (2017), The Pocket Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas and Design Effective Solutions, Rockport publishers, ISBN:9781631593741<br>3. Donald A Schon (1984), The reflective practitioner: How professionals think in action, Basic Books, ISBN:9780465068784 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Digital Sketching and Modelling | Course Code | DS5008 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 1 | 0 | 3 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | Studies of Form and Design Sketching | Approved In | Senate-44 | | | |
| Learning Objectives | • To introduce the advanced sketching and modelling concepts needed for product design<br>• To provide hands-on training in computer-based sketching and 3D modelling tools. | | | | | |
| Learning Outcomes | Students will be able to demonstrate drawing and modelling skills to communicate the design ideas/concept products using computer-based tools | | | | | |
| Contents of the course (With approximate break up of hours) | **Module-1: Digital Product Sketching (21 hrs)**<br>● Introduction to computer-based sketching tools (3 hrs)<br>● Digital sketching of planar shapes, curved shapes and objects (6 hrs)<br>● Digital sketching of concept products (9 hrs)<br>● Colors and material representation using software (3 hrs)<br>**Module-2: 3D Modeling (21 hrs)**<br>● Introduction to computer-based modeling tools (6 hrs)<br>● Development of 3D forms and objects using software (6 hrs)<br>● Photorealistic rendering using software tools (3 hrs)<br>● Product animation and concept presentation / AR/VR immersive experience (3 hrs)<br>● Artificial intelligence led improvisation in design (generative design) (3 hrs)<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Caplin. S, Banks. A, Holmes. N (2003); The Complete Guide to Digital Illustration, Watson-Guptill Publications, ISBN:9780823007844<br>2. R. Gil (1991); Basic Rendering: Effective Drawing for Designers, Artists and Illustrators, Thames & Hudson, ISBN:9780500276341<br>3. S. Robertson and B. Thomas (2012); How to Render: the fundamentals of light, shadow and reflectivity, Design Studio Press, ISBN:9781933492964 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Bio-inspired design | Course Code | DS5009 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | Design Research | Approved In | Senate-44 | | | |
| Learning Objectives | • To give the student an exposure of bio-inspired design principles<br>• To train the student in applying the bio-inspired methodologies for innovation<br>• To introduce different perspectives of bio-inspired design and future scope of this valuable domain | | | | | |
| Learning Outcomes | After completion of this course, the student is expected to:<br>• Describe methods for creative design<br>• Identify mechanical working principles of biological phenomena - explain their construction, motion, and/or processing mechanisms - formalize the essence, derive non-conventional design principles<br>• Implement them in innovative devices - summarize the transition process from the biological to the mechanical domain - present their design in drawings and working models. | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Introduction (6 hrs)**<br>• Basic principles, building blocks, material property charts, how the study of nature's designs can help engineers, examples of successful biomimetic designs. Mechanical design – hierarchical construction, bio-composites, structure & properties of bamboo, silks, bones, teeth, shells, antlers and beaks, impact resistance, fracture mitigation, damping, self-healing.<br>**Module 2: The Bio-inspired Design Approach (3 hrs)**<br>• Finding the biological information, Dealing with friction, Innovative designing with ACRREx (Abstracting, Categorizing, Reflecting, Reformulating and Extending) method.<br>**Module 3: Bio-inspired Design Methodology (6 hrs)**<br>• Problem solving, TRIZ, innovation and efficiency, functions, integration between biology design and innovation, methodology chart.<br>**Module 4: Bio-designing Perspectives (27 hrs)**<br>• Materials and surfaces: Muscles and artificial muscles, lotus effect, gecko adhesion, Desert beetle, pitcher plants, bio-fouling, coatings. Silver ant and heat dissipation, insulation of fur and feathers, constructal theory.<br>• Sensors: Biological sensors, Bio-inspired sensors<br>• Control: Robot controllers, Soft robotics, Bio-inspired Artificial intelligence (Evolutionary & Developmental Systems, Neural Systems, Immune Systems, Behavioral Systems and Collective systems)<br>• Bio-optics – structural colors, compound eyes, antireflection, stealth, imaging<br>• Navigation – short- and long-range navigation techniques of bees, ants, turtles & migratory birds.<br>• Bio-inspired design task<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Dario Floreano and Claudio Mattiussi (2008), Bio-Inspired Artificial Intelligence, MIT Press, ISBN:9780262062718<br>2. Reich Y (1995), A critical review of General Design Theory. Research in Engineering Design, 7 (1) 1-18, https://doi.org/10.1007/BF01681909<br>3. Maria G. Trotta (2011), Bio-inspired Design Methodology, Intl Journal of Info Science 1(1), pp 1-11, doi: 10.5923/j.ijis.20110101.01<br>4. Yoseph Bar-Cohen (2016), Biomimetics: Nature-Based Innovation, CRC Press, ISBN:9781439834763<br>5. Ashok K G, Daniel A McAdams, Robert B. Stone (2013), Biologically inspired designs, Springer London, ISBN:9781447152477<br>6. Lakhtakia A, Martin-Palma RJ (eds) (2013), Engineered biomimicry; Elsevier, ISBN:9780124159952<br>7. Lawrence Shapiro (2019), Embodied Cognition, Routledge, 2nd Edition, ISBN:9781351719162 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Design for quality and reliability | Course Code | DS5010 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | Probability and Statistics at undergraduate level | Approved In | Senate-44 | | | |
| Learning Objectives | The objectives of the course are to help engineering students understand:<br>• To understand concepts of quality and reliability<br>• To evaluate the overall reliability of a system from component reliability. | | | | | |
| Learning Outcomes | On completion of the course, students are able to:<br>● Model repairable and non-repairable systems and calculate failure/repair rate, reliability, availability<br>● Use various probability density distributions significant to reliability calculations<br>● Fit a given failure dataset of a product into a Weibull distribution and estimate the reliability | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Concepts of Product Quality and testing (6)**<br>● Quality Function Deployment / House of Quality<br>● Software testing for quality<br>● Electronic products testing for quality<br>**Module 2: Concepts of Reliability (9)**<br>● Basic concepts of repairable and non-repairable systems<br>● Reliability, Availability and Maintainability<br>**Module 3: Failure data analysis (9)**<br>● Fitting discrete and continuous distributions to failure data sets, Weibull analysis, estimation of important reliability parameters<br>**Module 4: Calculation of System Reliability from Component reliabilities (12)**<br>● Markov modeling of repairable and non-repairable systems<br>● Reliability Logic Diagrams<br>● Fault-tree analysis<br>**Module 5: Preventive and Predictive maintenance (6)**<br>● Failure Modes and Effects Analysis<br><br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. B.L. Hansen & P.M. Ghare (1997), Quality Control and Applications, Prentice-Hall, ISBN:9788120307940<br>2. Louis Cohen, Joseph P. Ficalora (2009), Quality Function Deployment and Six Sigma, Prentice Hall, 2nd Ed, ISBN:9780133364439<br>3. Patrick O'Connor (2012), Practical Reliability Engineering, John Wiley, ISBN:9780470979815<br>4. VNA Naikan (2010), Reliability Engineering and Life Testing, PHI Learning, ISBN:9788120335936<br>5. Singiresu S Rao (2014), Reliability Engineering, Pearson Education, ISBN:9780136015727 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Interaction design (UX / UI) | Course Code | DS5011 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | 1. To introduce students to interaction design for a variety of applications.<br>2. To provide principles, patterns and processes for interaction design, rapid prototyping, user interface (UI) and user experience (UX) design<br>3. To develop skills that can be applied to web publishing, mobile app development, game development, entertainment and artistic performances | | | | | |
| Learning Outcomes | Upon successful completion of this course, students are able to:<br>● Identify basics of both analog and digital interactions<br>● Apply disciplined visualization and the design process, implementing design principles<br>● Understand the history of interaction design and explore current trends in user experience design | | | | | |
| Contents of the course (With approximate break up of hours) | **Module:1: Introduction and State of the Art (12 hrs)**<br>● Touch Screens vs. real touch and feeling<br>● Inspirations from food, fashion, and fitness<br>● Interaction paradigms and materials for real "touch"<br>**Module-2: Going beyond heads-down interaction (24 hrs)**<br>● Building interfaces that allow users to be adventurous and individual<br>● UX as performance<br>● Moving towards mindful interaction<br>● The bigger picture<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Don Norman (1988), Design of everyday things, Basic books, ISBN:9780465003945<br>2. Donald A Norman (2007), The design of future things, Basic Books, New York, ISBN:9780465002276<br>3. Garrett J J (2010), The elements of user experience: User-centered design for the web, New Riders, ISBN:9780321624642<br>4. Dan Saffer (2009), Designing for interaction: Creating innovative applications & devices, New Riders, ISBN:9780321643391<br>5. Greenberg, S., Carpendale, S., Marquardt, N., & Buxton, B. (2011), Sketching user experiences: The workbook, Morgan Kaufmann, ISBN:9780123819598<br>6. Steve Krug (2015), Don't make me think, Revisited, 3rd edition, Pearson Books, ISBN:9789332542860<br>7. Simon Robinson, Gary Marsden, Matt Jones (2014), There's Not an App for That – Mobile User Experience Design for Life, Morgan Kaufmann Publishers, ISBN:9780124166912 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Human Factors & Ergonomic Design | Course Code | DS5012 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | The objective of this course is to help students understand<br>• Different physical, physiological and psychological capabilities and limitations of human beings,<br>• Generation of ergonomic specifications<br>• Application of ergonomic principles to various products, interfaces and environments for maximizing user satisfaction and minimizing risk involved in the usage of the design | | | | | |
| Learning Outcomes | On completion of the course, students will be able to:<br>• Apply the concepts of the human factors and ergonomics in design to complete the several projects in relation to various disciplines | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Introduction and overview (10 hrs)**<br>• History of human factors, multi-disciplinary engineering, human machine system, characteristics of system, information theory, types of information, selection of display modality, coding of information, compatibility, memory, decision making, attention, text, graphics, symbols, quantitative visual display, representational display, auditory, tactual and olfactory displays.<br>**Module 2: Anthropometry (10 hrs)**<br>• Need for anthropometry, data collection methodology, measuring procedures, tools, statistical analysis of data for percentile calculation, anthropometric measurements, percentile calculation, usage of the anthropometric percentile values, ergonomic guidelines for products, equipment and accessories, anthropometry in applications<br>**Module 3: Biomechanics (12 hrs)**<br>• Biostatics – static equilibrium equations, musculoskeletal system, problems in mechanics of upper extremity and hand, lower extremity and foot, bending, lifting and carrying,<br>• Biodynamics – linear kinematics, angular kinematics, human body kinetics, human body impact and collision, surface electromyogram, electrocardiogram and heart rate measurement<br>**Module 4: Virtual ergonomics (10 hrs)**<br>• Digital Human Modeling (DHM), anthropometric models, models for production design, biomechanical models, anatomical models, cognitive models,<br>• DHM packages – selection strategies, Functionalities, Virtual ergonomics evaluation techniques – Rapid Upper Limb Assessment, field of vision, reach envelopes, accessibility and clearance analysis, discomfort analysis, Applications of DHM<br><br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. M. S. Sanders and Ernest J. McCormick (1992), Human Factors in engineering and Design, McGraw-Hill International Editions, ISBN:9780070549012<br>2. Duffy V G (2009), "HandBook of Digital Human Modeling: Research for Applied Ergonomics and Human Factor Engineering", Taylor & Francis, ISBN:9780805856460<br>3. Chandler Allen Phillips (2000), "Human Factor Engineering", John Wiley & Sons, Inc, ISBN:9780471240891<br>4. D Chakrabarti (1997), "Indian Anthropometric Dimensions for Ergonomic Design Practice", National Institute of Design, Ahmedabad, doi:10.1177/106480469900700210<br>5. G Salvendy (1997), "Handbook of Human Factors and Ergonomics", John Wiley & Sons, Inc., ISBN:0471116904 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Embodiment Design Project | Course Code | DS5013 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 1 | 0 | 6 | 5 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | The objective of this course is to encourage the students to translate their concepts into a minimum viable product (PoC) using all the theories, methods and tools learnt in the 1st and 2nd semester courses | | | | | |
| Learning Outcomes | Students will develop skills in workshop practice and rapid prototyping; project management and focusing on delivering outcomes | | | | | |
| Contents of the course (With approximate break up of hours) | **Module-1: Minimum viable product plan (3 hours)**<br>● Markets and Needs<br>● Business Goals<br>● Key features<br>**Module-2: Core Product Architecture (6 hours)**<br>● Storyboarding of the product core<br>● Framework for mechanical, electronics and computing paradigm<br>**Module-3: Design for Manufacture & Assembly (3 hours)**<br>● Manufacturing Process: Form<br>● Assembly constraints: Fit<br>● HF/Ergonomic considerations<br>● Interaction design<br>● Quality and Reliability considerations<br>**Module-4: Developing the Proof of Concept (30 hours)**<br>● Build<br>● Assemble<br>● Iterate<br>● Validate<br>● Pitch<br>Evaluation: 70% Continuous assessment + 30% Final Demo | | | | | |
| Essential & Supplementary Readings | 1. Snyder, C. (2003); Paper prototyping: The fast and easy way to design and refine user interfaces, Morgan Kaufmann, ISBN:9781558608702<br>2. Bjarki Hallgrimsson (2012), Prototyping and Modelmaking for Product Design, Lawrence King Publishing, ISBN:9781856698764<br>3. Elaine Chen (2015), Bringing a Hardware Product to Market: Navigating the Wild Ride from Concept to Mass Production, ISBN:9781505380835<br>4. Sean Michael Ragan (2017), The Total Inventors Manual: Transform Your Idea into a Top-Selling Product, Weldon Owen, ISBN: 9781681881584<br>5. Jake Knapp, John Zeratsky, Braden Kowitz (2016), How to Solve Big Problems and Test New Ideas in Just Five Days, Transworld Digital, ISBN:9781501121746 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Design of Hybrid and Electric Vehicle | Course Code | DS5100 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | B.Tech (Mechanical / Electrical) | Approved In | Senate-44 | | | |
| Learning Objectives | This course will provide a broad technical knowledge and practical expertise of hybrid and electric vehicle (HEV) technologies, analysis, design, component selection and sizing at both system and vehicle level. | | | | | |
| Learning Outcomes | On successful completion of this course students will be able to:<br>● Analyse the different powertrain architecture options and select the appropriate solutions within realistic performance and commercial constraints.<br>● Evaluate various technology options for (electrical and mechanical) energy generation, storage, transmission, and management for a HEV<br>● Size various HEV systems, within the constraints like performance, fuel economy and packaging. | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Introduction to Electric Vehicle (3 hrs)**<br>● History and Components of Electric Vehicle, Comparison with Internal Combustion Engine: Technology, Benefits and Challenges, EV classification and their electrification levels and terminologies<br>**Module 2: Motor Torque Calculations for Electric Vehicle (6 hrs)**<br>● Calculating the rolling resistance, grade resistance, acceleration, force and finding the total tractive effort, torque required on the drive wheel.<br>**Module 3: Electric Vehicle Architecture Design (9 hrs)**<br>● Types of EV and components, electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV)<br>● Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV<br>**Module 4: Electric Drive and controller (6 hrs)**<br>● Types of motors, selection and sizing of motor, RPM and torque calculation of motor, motor controllers, component sizing, physical locations, mechanical and electrical connection of motor<br>**Module 5: Energy Storage Solutions (ESS) (6 hrs)**<br>● Cell Types (Lead Acid/Li/NiMH), battery charging and discharging calculation, cell selection and sizing, battery lay outing design, battery pack Configuration, construction and selection criteria.<br>**Module 6: Battery Management System(BMS)/Energy Management System (EMS) (6 hrs)**<br>● Need of BMS, rule based control and optimization based control, software-based high level supervisory control, mode of power, behavior of motor etc<br>**Module 7:Electric Vehicles charging station (6 hrs)**<br>● Type of charging station, selection and sizing of charging station, components of charging station, single line diagram of charging station<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. C.M. Jefferson & R.H. Barnard (2002), Hybrid Vehicle Propulsion, WIT Press, ISBN: 9781853128875<br>2. James Larminie and John Lowry (2012), Electric Vehicle Technology Explained, Oxford Brookes University, Oxford, UK, ISBN:9781119942733<br>3. John Miller (2010), Propulsion Systems for Hybrid Vehicles, Institute of Electrical Engineers, UK, ISBN: 9781849191470<br>4. Iqbal Husain (2010), Electric and Hybrid Vehicles – Design Fundamentals, CRC Press, ISBN:9781439811757<br>5. Chris Mi, M A Masrur, D W Gao (2011), Hybrid Electric Vehicles – Principles and applications with practical perspectives," Wiley, ISBN:9780470747735<br>6. Vivek D Bhise (2017), Automotive product development: A systems engineering implementation, CRC Press, ISBN:9781498706810 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Design of Medical Devices | Course Code | DS5101 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | • Introduce the process of medical device design - the non-technical factors that impact a medical technology's clinical and market success, and to emerging themes that are shaping healthcare innovation<br>• Challenge students to apply design thinking to the broader healthcare system. | | | | | |
| Learning Outcomes | On successful completion of this course,<br>• Students gain exposure to clinical need identification, stakeholder interviews, ideation, and prototyping.<br>• Students will become experts on intellectual property, FDA regulation, reimbursement, and start up financing introduce non-technical factors that help shape an innovation's path to impact. | | | | | |
| Contents of the course (With approximate break up of hours) | • Introduction – Medical Device Development: Academia vs. Industry<br>• Project Management – How corporations manage medical projects<br>• Pre-clinical Device Development – Research projects<br>• Regulatory considerations for medical device development<br>• Manufacturing, Quality Control, and Quality Assurance<br>• Business – What makes corporations tick and research labs tock<br>• Marketing medical devices, and the basics of sales forces<br>• Clinical trials, CRA's, and CRO's<br>• Design Controls: DHF, Proposal, DDP, Inputs, Outputs, Specifications<br>• Design Controls: Verification, Validation, Transfer<br>• Risk Analysis: FMECA, Risk analysis document<br>• Organization types, putting together project teams, Project Management: The Sequel<br>• Consultants – Role in medical device development, Advamed, Anti-kickback statute, Confidentiality<br><br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Paul H. King, Richard C. Fries (2009), Design of Biomedical Devices and Systems, CRC Press, ISBN:9781420061796<br>2. Richard C. Fries (2001), Handbook of Medical Device Design, Taylor & Francis, ISBN:9780429285141<br>3. Peter Ogrodnik (2019), Medical Device Design, Academic Press, ISBN:9780128149638<br>4. Paul Davim (2012), The Design and Manufacture of Medical Devices, Woodhead Publishing, ISBN:9781908818188 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Embedded Kinetic Artwork | Course Code | DS5102 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | Undergraduate engineering | Approved In | Senate-44 | | | |
| Learning Objectives | • Introduce the concept of sculpture and history.<br>• Design concepts of the sculpture and kinetic sculpture<br>• Aesthetics and kinetic art work in building sculpture.<br>• Embedded systems, sensors, actuators and programming models to realize the kinetic sculptures. | | | | | |
| Learning Outcomes | Students understand *creative problem solving b*oth in engineering and the arts.<br>Students can understand and design the moving and innovative sculptures | | | | | |
| Contents of the course (With approximate break up of hours) | **Module-1: Programming and Electronics fundamentals (18 hrs)**<br>• Programming fundamentals<br>• Electronics fundamentals– Input sensors (switches, potentiometers, resistive sensors including light, temperature, flex, etc., rangefinders, optical switches, etc.)– Output actuators (servos, DC motors, stepper motors, LEDs, relays, switching transistors, etc.)<br>• Programming reactive systems– External chip interfacing with protocols such as SPI – Interrupt prog<br>**Module-2: Constructing Kinetic Art (24 hrs)**<br>• Art history review of kinetic art<br>• Discussion of contemporary kinetic artists (Jim Campbell, Jack Dollhausen, Arthur Ganson, Rebecca Horn, Dan Rozin, Sabrina Raaf, Alan Rath, Peter Vogel, etc.)<br>• Formal elements of 3d art such as aesthetics, proportion, and balance<br>• Material studies (plastic, metal, paper, wood, etc.)<br>• Mechanical linkages and physical construction<br>• Concepts and meaning in art– Artistic design process<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Candy, Linda, Edmonds, Ernest, Poltronieri, Fabrizio Augusto (2018), Explorations in Art and Technology, Edition 2, Springer-Verlag London, ISBN:9781447173663<br>2. T. Igoe (2004). Physical Computing: Sensing and Controlling the Physical World with Computers, Edition 1, Premier Press, ISBN:9781592003464<br>3. Massimo Banzi (2011), Getting Started with Arduino, Edition 2, O'Reilly, ISBN-13: 9781449309879.<br>4. J. Noble. Programming Interactivity: A Designer's Guide to Processing, Arduino, and Open Frameworks, O'Reilly Media, Inc., ISBN:9781449311445<br>5. C. Reas, B. Fry, and J. Madea (2015), Processing: A Programming Handbook for Visual Designers and Artists. The MIT Press, ISBN:9780262028288<br>6. H. Yanco, H. J. Kim, F. G. Martin, and L. Silka (2006), Artbotics: Combining art and robotics to Broaden participation in computing. In AAAI: Resources forAI Education, Stanford, CA.<br>7. H. J. Kim, D. Coluntino, F. G. Martin, L. Silka, and H. A. Yanco (2007), Artbotics: community-based collaborative art and technology education. In SIGGRAPH '07: Educators Program, San Diego, California, | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Strategic management of design and innovation | Course Code | DS6002 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | • To help designers understand the innovation challenge from entrepreneurial/managerial perspectives<br>• To introduce designers to the different paradigms and processes of managing product innovation | | | | | |
| Learning Outcomes | On completion of the course, students will have a familiarity with:<br>● Innovation processes and structures such as R&D team, the pros and cons of various R&D organizational structures, and challenges of innovation in large and small firms; | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Introduction (9hrs)**<br>● Innovation – multi-disciplinary perspective<br>● Innovation as a new management object<br>● Processes used to explore innovations along the technology, market and strategy dimensions<br>**Module 2: Design activity and Innovation capability (9hrs)**<br>● Design: An activity underlying all innovations<br>● Innovative design – an approach for transforming identity of objects<br>**Module 3: Design capacities in innovative firms (12hrs)**<br>● Case studies of highly innovative firms<br>**Module 4: Innovative design: tools & organizational strategies (12 hrs)**<br>• Strategies to effectively exploit the value of innovation, including innovation platforms that include multiple products, portfolios, standards and business models<br>• Processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their foundations in the face of disruptive innovations<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Christensen, Clayton M. (2003), The innovator's solution: creating and sustaining successful growth, Harvard Business Press, ISBN:9781578518524<br>2. Joe Tidd and John Bessant (2013), Managing Innovation: Integrating Technological, Market and organizational change, Wiley, ISBN:9781118360637<br>3. Paul Trott (2011), Innovation Management and New Product Development, Pearson, 5th Edition, ISBN:9780273736561<br>4. Ralph D Stacey (2012), The Tools and Techniques of Leadership and Management: Meeting the challenge of complexity. Routledge, London, ISBN:9780415531177<br>5. Pascal Le Masson, Benoit Weil and Armand Hatchel (2012), Strategic management of innovation and design, Cambridge University Press<br>6. Raymond Turner (2016), Design Leadership: Securing the Strategic Value of Design, Routledge, ISBN:9781138247635<br>7. Tan, Garry, Chapman, Anne (2017), Design Leadership & Mgmt: A Case Study in Singapore, Springer, ISBN:9789463511551 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Sustainable Product Service Systems | Course Code | DS6003 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Core | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | • To introduce concepts of sustainable design of product-service systems<br>• To provide an understanding of methods and tools for sustainable design | | | | | |
| Learning Outcomes | At the end of the course, the students should be able to appreciate<br>• Product-service systems which are also referred to as servicing, resource-efficient business models, green business models, or circular business models<br>• create designs that are sustainable in terms of environmental burden and resource use, whilst developing product concepts as parts of sustainable whole systems, that provide a service or function to meet essential needs | | | | | |
| Contents of the course (With approximate break up of hours) | Module 1: Introduction to Product Services systems (6hrs)<br>• Socio-technical systems<br>• Environmental Impact<br>Module 2: Environmentally-responsive design methodologies (18hrs)<br>• Industrial ecology<br>• Dematerialization<br>• Design for reuse / modularity<br>• Design for recycling<br>• Remanufacturing: issues/problems, current and future developments<br>Module 3: Alternative resources (10 hrs)<br>• Alternative energy<br>• Alternative materials<br>• Sustainable packaging.<br>Module 4: Life-cycle assessment methods (8hrs)<br><br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Victor Papanek (1995), The Green Imperative: Ecology and ethics, Thames and Hudson, ISBN:9780500278468<br>2. William McDonough and Michael Braungart (2002), Cradle to Cradle, North Point Press, ISBN:9780865475878<br>3. Stuart Walker (2006), Sustainable by Design: Explorations in Theory and Practice, Routledge, ISBN:9781844073535<br>4. Charter, Tischner (2001), Sustainable Solutions, Green Leaf Publishing, ISBN:9781351282482<br>5. Cattanach, Holdreith, Reinke, Sibik (1994), The Handbook of Environmentally Conscious Manufacturing, ISBN:9780786301478<br>6. Sim van der Ryn, Stuart Cowan (2013), Ecological Design, Island Press, ISBN:9781559633895<br>7. Paul Hawken (2010), The Ecology of Commerce, Collins Business Essentials, ISBN:9780061252792<br>8. Nattrass & Altomare (1999), The Natural Step for Business, New Society Publishers, ISBN:9780865713840<br>9. Vance Packard (2011), The waste makers, Ig Publishing, Reprint edition, ISBN:9781935439370 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Mathematics for Designers | Course Code | DS6100 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | Basic mathematics | Approved In | Senate-44 | | | |
| Learning Objectives | To develop an understanding of mathematical principles behind algorithms for innovative design by bringing together mathematics, computer science, engineering design and art | | | | | |
| Learning Outcomes | • Understand mathematical logic behind structures;<br>• Ability to develop mathematical models for generative art | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Origami and paper folding (9 hrs)**<br>• History of Origami,<br>• Physical and geometric properties of paper and folding,<br>• Special types of origami: pureland, box-pleating, tiling, circle packing<br>**Module 2: Geometry and mathematical design (15 hrs)**<br>• Basic on fractal geometry and dimensions.<br>• Fractal concepts applied to design<br>• Julia set, Mandelbrot set<br>• Phi, golden ratio and golden angle in product design,<br>• Polyhedra and platonic solids.<br>**Module 3: Geometric folding algorithms (18 hrs)**<br>• Upper and lower bounds<br>• Planner linkage mechanism<br>• Rigid frameworks<br>• Reconfiguration of chains<br>• Locked chains<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Bovill, Carl (1996), Fractal Geometry in Architecture and Design, Boston: Birkhäuser, ISBN:97814612691822. Demaine, Erik, and Joseph O'Rourke (2007), Geometric Folding Algorithms: Linkages, Origami, Polyhedra. Cambridge University Press, ISBN:97805218578743. George Stiny (2008), Shape – Talking about seeing and doing, MIT Press, ISBN:97802626936774. Lang, Robert (2011), Origami Design Secrets: Mathematical Methods for an Ancient Art, CRC Press, ISBN:9781568814360 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Model Based Design and Manufacturing | Course Code | DS6101 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | This course will provide a broad technical knowledge and practical expertise of system requirements, design, analysis, verification and validation activities to enhance design and manufacturing capabilities. Students will gain an understanding of systems engineering, the model-based approach to design and manufacturing, the Digital Twin, and a roadmap toward a model-based enterprise. | | | | | |
| Learning Outcomes | On successful completion of this course students will be able to:<br>● Explain the value and expectations of systems engineering and model-based systems engineering, and the underlying motivations and opportunities represented by a model-based enterprise. They will develop the knowledge necessary to perform a baseline assessment of an organization's potential to leverage model-based systems engineering. | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1: Introduction to Systems Engineering (6 hours)**<br>● Definition and properties of a system<br>● Systems Engineering and the LifeCycle<br>● Systems Engineering Process Overview<br>● Business Impacts of Systems Engineering<br><br>**Module 2: Model-Based Systems Engineering (8 Hours)**<br>● Model-Based Definition<br>● Model-Based Systems Engineering Methodologies<br>● Systems Modelling Language (SysML)<br>● Model-Based Systems Engineering (MBSE) Application Strategies<br>● Verification and Validation Strategies<br><br>**Module 3: Applications of Model-Based Systems Engineering (4 hours)**<br>● Model-Based Enterprise<br>● Digital Thread& Digital Twin<br>● Business Aspects of the Model-Based Enterprise<br>● Realizing a Model-Based Enterprise<br><br>**Module 4: Model-Based Enterprise (8 hours)**<br>● Design Activities<br>● Configuration Management and Document Management<br>● Manufacturing Planning Activities<br>● Quality Requirements and Quality Planning Activities<br>● Enterprise Activities<br>● Your 4.0 Roadmap to Success<br><br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. David Long and Zane Scott (2012), A primer for model-based systems engineering, Vitech Corporation, ISBN:9781105588105<br>2. Jose L. Fernandez and Carlos Hernandez (2019), Practical Model Based Systems Engineering, ARTECH, ISBN:9781630815790<br>3. Sanford Friedenthal, Alan Moore and Rick Steiner (2015), A practical guide to SysML – The Systems Modelling Language, The MK/OMG Press, ISBN:9780128002025 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Simulation Driven Design | Course Code | DS6102 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | This course will give theory and hand-on-training to conduct simulation across the product lifecycle from concept design to in-service operation across multiple disciplines encompassing structures, motion, fluids, thermal management, electromagnetics, system modelling and embedded systems, while also providing data analytics and true-to-life visualization and rendering. | | | | | |
| Learning Outcomes | On successful completion of this course students will be able to:<br>• Demonstrate their software skills in the multi-disciplinary simulations including structural, fluids, thermal, manufacturing, systems modelling, IoT and multiphysics. | | | | | |
| Contents of the course (With approximate break up of hours) | **Topics to be covered:**<br>• Basic concept of finite element method<br>• Modelling techniques<br>• Mesh types<br>• Boundary constraints<br>• Material and Properties<br>• Mechanical and thermal stress analyses<br>• Dynamic response – impact and crashworthiness<br>• Product optimization in terms of product size, shape and material<br>• Non-linear stress analysis<br>• Casting and deep drawing<br>• Structural Optimization<br>• System Modelling and Control Systems<br>• Composite Analysis & Optimization<br>• Design of Experiment (DoE) Studies<br>• Electromagnetic simulation<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. S.S. Rao (2018), The finite element method in engineering, Butterworth-Heinemann Publishers, UK, ISBN:9781856176613<br>2. Nam-Ho Kim (2018), Introduction to Non-linear finite element analysis, Springer, ISBN:9781441917454<br>3. NAFEMS (1992), A finite element primer, Bookcraft Ltd.<br>4. Paul Jacob and Lee Goulding (2002), An explicit finite element primer, NAFEMS Ltd., ISBN:9781874376453<br>5. A.A. Becker (2001), Understanding Non-linear finite element analysis, NAFEMS Ltd., ISBN:9781874376354 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Design of non-invasive systems | Course Code | DS6103 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | This course is to cultivate the skill of appreciating the communication between system (Bio and mechanical) and environment. Further, plan the device to diagnose systems using suitable tools of noninvasive monitoring. | | | | | |
| Learning Outcomes | After the completion of the course students will be in a position to appreciate the system-environment interaction and them decide on suitable tools such as electronic, acoustical, optical, photonic etc. | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1 (6 hrs)**<br>● Introduction to non-invasive technologies, future perspectives<br>● System - environment interaction, modes and ways: Understanding<br>**Module 2 (6 hrs)**<br>● Design considerations for interaction quantification<br>**Module 3 (30 hrs)**<br>● Tools for noninvasive medical and machine monitoring<br>● Acoustic (Sonic)<br>● Electronic and electrical<br>● Photonic<br>● Optical<br>● Exploiting DSP, AI and ML<br><br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Jessica Fitzgerald and Hicham Fenniri (2017), Cutting Edge Methods for Non-Invasive Disease Diagnosis Using E-Tongue and E-Nose Devices, Biosensors (Basel). Dec; 7(4): 59, https://doi.org/10.3390/bios7040059<br>2. Irfan Muhammad (2018), Advanced Condition Monitoring and Fault Diagnosis of Electric Machines, IGI Global, ISBN:9781522569909<br>3. John G. Webster (2020), Minimally Invasive Medical Technology, CRC Press, ISBN:9780367455415 | | | | | |

# Curriculum & Syllabus

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|---|---|---|---|---|---|---|
| Course Name | Wearable Technologies | Course Code | DS6104 | | | |
| Offered by Department | SIDI | Structure (LTPC) | 2 | 1 | 0 | 3 |
| To be offered for | M.Des | Course Type | Elective | | | |
| Prerequisite | NIL | Approved In | Senate-44 | | | |
| Learning Objectives | This course aims to present wearable product designers with realistic, reliable knowledge of human anatomy and function from a design perspective. | | | | | |
| Learning Outcomes | After completing the course, students will be able to structure wearable products that enhance health, performance, safety, and pleasure. | | | | | |
| Contents of the course (With approximate break up of hours) | **Module 1 (6 hrs)**<br>• Wearables: Fundamentals, Advancements, and a Roadmap for the Future<br>• Human Body Diversity: Opportunity and Challenge<br>• Wearable Product as Mediator between Environment and Human Body<br>• Anthropometry and pattern grading<br>**Module 2 (12 hrs)**<br>• Stability and Motion: Interactions in a Neuro-Musculo-Skeletal System<br>• Integumentary System: Coverage and Protection<br>• Wearable Electronics from Foils to Textiles: Materials, Devices, and Assembly<br>• Energy Harvesting at the Human Body<br>**Module 3 (12 hrs)**<br>• Low-Power Integrated Circuit Design for Wearable Biopotential Sensing<br>• Mining Techniques for Body Sensor Network Data Repository<br>• Modeling Physical Activity Behavior Change<br>• Wireless Body Area Networks<br>**Module 4: (12 hrs)**<br>• Wearable Sensors for the Monitoring of Physical and Physiological Changes in Daily Life<br>• Wearing Sensors Inside/ Outside of the Human Body for the Early Detection of Diseases<br>• Wearable and Non-Invasive Assistive Technologies<br>Evaluation: 70% assignments/activities + 30% End Semester | | | | | |
| Essential & Supplementary Readings | 1. Edward Sazonov and Michael R. Neuman (2014), "WEARABLE SENSORS Fundamentals, Implementation and Applications", Elsevier, ISBN:9780124186620<br>2. Sahrye Cohen and Hal Rodriguez (2018), Make It, Wear It: Wearable Electronics for Makers, Crafters, and Cosplayers, McGraw-Hill Education, ISBN:9781260116151<br>3. Karen L. LaBat and Karen S. Ryan (2019), "Human Body - A Wearable Product Designer's Guide", CRC Press Taylor & Francis group, ISBN:9781498755719<br>4. Gang Wang, Chengyi Hou and Hongzhi Wang (2020), "Flexible and Wearable Electronics for Smart Clothing", Wiley, ISBN:9783527818556 | | | | | |