Department of Design

Indian Institute of Technology Guwahati

Proposal for Course Structure of MDes in Electronic Product Design (EPD)

A memorandum of understanding has been signed between Ministry of Electronics and Information Technology, Government of India and Indian Institute of Technology Guwahati for developing human capital in the area of electronic product design. One of the initiatives in this direction is to start a MDes Program in Electronics Product Design. The graduating students are expected to be skilled at design and development of electronic products, services and applications targeting various segments like toy designs and services, healthcare products and ecosystem, mobile devices and services, electronic components, and industrial products. In addition to designing electronic products and services, the program also aims to create skilled human resources in Industry 4.0, especially targeting the ability to virtually prototype, train and design electronic products and services.

Intended skill sets among the graduating students

Through the proposed program, the Department of Design aims to impart the following skill sets and expertise in graduating students:

- ***Human-centered design processes and methods*** where students will learn methods and approaches of human centered design including but not limited to user research, analysis, empathy mapping, design research and designing products and services
- ***Electronic product design and detailing*** where students will learn about the product design aspect and product details for designing electronic devices
- ***Design for manufacturing*** to educate students on manufacturing process and methods to develop innovative electronic products
- ***Materials and manufacturing processes*** to impart skills about various materials, their capabilities, strength and weaknesses and manufacturing processes for dedicated to different materials
- ***Form and structure exploration, visualization, and analysis*** where students will learn about product form, product structure, features and functionalities, product aesthetics, and product visualization to design useful, meaningful, usable and pleasurable electronic products and services
- ***User Experience (UX) design*** where students will learn to design the digital experiences via learning the requirement gathering, features and functions, navigational flow, task flows, and wireframes of electronic products and services
- ***Designing interaction techniques and user interfaces*** to educate upon approaches to design input methods and techniques for natural, intuitive and engaging interactions and interfaces
- ***Designing Virtual Reality (VR) prototyping and training platforms*** to educate to use VR for building 1:1 virtual prototypes, evaluate them for aesthetics, functions, ergonomics and others and building training and simulation services for electronic products
- ***Design for environmental sustainability*** to educate students on product design processes that adopt sustainable methods and approaches to design environment friendly products and services
- ***Human factors*** where students learn the concepts of physical and cognitive ergonomics that significantly impact on long term product usage, acceptance and adoption

- ***Systems thinking*** where students learn about the holistic approach on how system's component interrelate and how systems work over time and within the context of larger systems.
- ***Standards and regulatory norms in EPD*** to learn about rules, guidelines, common and repeated use, product characteristics or related processes and methods

In addition to primary skill sets that we aim to impart in graduating students, the department will also educate the basics on quick and easy software and hardware prototyping, applications of ready to use sensors, actuators and microcontrollers, Internet of Things (IoT) architecture and computing and virtual reality.

Number of seats in each academic year

30 seats sponsored by Ministry of Electronics and Information Technology, Government of India for the first 4 batches.

Eligibility criteria

Full Time (Regular)

To apply for admission to the M.Des. in EPD program offered by the Department of Design, a candidate must satisfy the following criteria:

- Four-year BTech or B.E. in Electrical/Electronics/ECE/EEE/Mechatronics/Computer Science/Computer Science & Engineering/Medical electronics/Instrumentation/Electronic & Telecommunication, Electronics & Instrumentation, Mechanical Engineering, or any combination of these disciplines with a minimum CPI of 6.0 out of 10 or minimum 60 of marks.
- The candidate must have cleared the CEED examination.

Relaxation for SC/ ST/ PwD Candidates

The CPI or percentage marks in above mentioned eligibility requirements will be relaxed by 0.5 CPI or by 5% marks for SC/ ST/ PwD candidates. That is, the SC/ ST/ PwD candidates should have a minimum CPI of 5.5 out of 10 or minimum 55 of marks in their qualifying degree.

No non-regular seats.

Course Curriculum Structure for MDes in EPD

Semester 1

Course Code	**Course title**	**L-T-P-C**
DD 542	Introduction to Industrial Design	2-0-0-4
DD 543	Product Design Methods	2-0-4-8
DD 5/6xx	Elective I	x-x-x-6

DD 544	Ergonomics in Product Design	2-0-2-6
DD 545	Rapid Prototyping and Development	0-1-4-6
		Total credits: 30

Semester 2

Course Code	**Course title**	**L-T-P-C**
DD 509	Interaction Design	2-1-0-6
DD 546	Product Form and Structures	0-1-4-6
DD 547	Design for Environmental Sustainability	1-1-0-4
DD 548	Embodiment Design	2-0-2-6
DD 549	Systems thinking	1-1-0-4
DD 5/6xx	Elective II	x-x-x-6
		Total credits: 32

Semester 3

Course Code	**Course title**	**L-T-P-C**
DD 608	Thesis Project (Phase I)	0-0-18-18
DD 5/6xx	Elective III	x-x-x-6
DD 609	Expert Workshop	0-0-2-0
		Total credits: 24

Semester 4

Course Code	**Course title**	**L-T-P-C**
DD 610	Thesis Project (Phase II)	0-0-24-24
		Total credits: 24

Total credits for all semesters – 110

DD 608: Thesis Project (Phase I) and DD 610: Thesis Project (Phase II) - The students will execute a collaborative electronic product design project. The collaboration will involve at least one faculty member from Department of Design and can involve faculty from other departments and industry partners.

DD 609 Expert Workshop - The course aims to acquaint students with the latest developments in the electronic product design field through invited talks, interactive sessions, workshops by industry and academia experts.

List of Electives

Proposed New Elective Courses of Department of Design

Course Code	Course title	L-T-P-C
DD 550	Image Processing with Machine Learning	3-0-0-6
DD 551	Biomedical Devices	3-0-0-6
DD 552	Design of Embedded Systems	2-0-2-6
DD 553	Basics of Digital Signal Processing	3-0-0-6
DD 554	Pattern Recognition and Machine Learning	3-0-0-6
DD 555	IoT Enabled Smart Grids	3-0-0-6
DD 556	Bio signals in medical device design	2-0-2-6
DD 557	Fundamentals of Sensors and their Applications	3-0-0-6

Existing Elective Courses of Department of Design

Course Code	Course title	L-T-P-C
DD 510	Creativity, Innovation and Design Management	3-0-0-6
DD 512	New Media Studies	1-2-0-6
DD 513	Lighting Design	1-0-4-6
DD 514	Collaborative Design Methods for New Product Development	1-2-0-6
DD 516	Digital Human Modelling and Simulation in Product Design	2-0-2-6
DD 517	Automobile Design	1-1-4-8
DD 521	System Design for Sustainability	2-0-2-6

DD 522	Furniture and Future	2-0-2-6
DD 524	Graphic Design Studio	0-1-4-6
DD 525	Structural Packaging Design	1-0-4-6
DD 527	Introduction to Toy Design	1-0-4-6
DD 528	Visual Language	2-0-3-7
DD 529	Information Design for Visual Communication	1-0-5-7
DD 531	Game Design	2-0-2-6
DD 533	Auditory and Voice User Interaction Design	2-1-0-6
DD 534	HCI in Virtual Reality	2-1-0-6
DD 537	Introduction to Service Design	2-0-2-6
DD 538	Additive Manufacturing and Design	1-0-4-6
DD 601	Usability Engineering	2-1-0-6
DD 604	Environment and Experiential Design	2-0-3-7
DD 607	Creativity and Innovation	2-0-2-6

Course Syllabus

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Course Number & Title: DD 542 Introduction to Industrial Design	
L-T-P-C: 2-0-0-4	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: M.Des in Electronic Product Design	
Offered in (Odd/ Even / Any): Odd	
Offered by (Name of Department/ Center): Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): The main objective of this course is to develop a better understanding of the perspective of Industrial Design and to gain experience regarding the role of an industrial designer.	
Course Content/ Syllabus Introduction to History and Evolution of Design: Beginnings of design/ industrial revolution. Design philosophy; Interrelationship of and engineering; Introduction to electronic product design; User centered considerations in Design; An overview of the practice of design (product design, visual communication, interaction design); diversity of approaches. Interdisciplinary collaboration – range of Design applications; Societal impact of Design; Critical issues in user-centered design; Role of creativity and innovation in Design. Case studies in Industrial Product Design	
Books (In case UG compulsory courses, please give it as "Text books" and "Reference books". Otherwise give it as "References".	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	D. Norman, *The Design of Everyday Things: Revised and Expanded Edition*, Basic Books, New York, 2013.
2.	Bernhard E. Bürdek, *Design: History, Theory and Practice of Product Design*, Birkhauser Verlag AG, 2005.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	P. Rodgers and A. Milton, *Product Design*, Laurence King Publishing, 2011.
2.	M. Droste, *Bauhaus 1919-1933*, Taschen America LLC., 2019.
3.	Joycelyn de Noblet, *Industrial Design 19th To 21st Century: Reflection of a Century*, Flammarion, 1996.
4.	C. H. Flurscheim Ed., *Industrial Design in Engineering – a marriage of techniques*, Springer, 2014.
5.	Dennis P. Doordan, *Design history: An Anthology (Design Issues Readers)*, The MIT Press,1996.
6.	M. N. Horenstein, *Design Concepts for Engineers*, 5th Edition, Pearson, 2015.

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Course Number & Title: DD 543 Product Design Methods	
L-T-P-C: 2-0-4-8	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: M.Des in Electronic Product Design	
Offered in (Odd/ Even / Any): Odd	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): This course gives an understanding of product design taxonomies, methods and methodologies for product design. The practical component of the course will help students apply appropriate design methods and tools to design and develop innovative products.	
Course Content/ Syllabus Introduction: Types of consumer products; Design space; User's perspective to products; Designer's perspective to products; New product development processes and methods. Approaches to Product Design: Design thinking; Material-driven design; Prototype-driven design; Brand-driven design; Industry approaches to Product Design. Innovation by Design: Modes of innovation by design; Methods of exploring problem structure; Methods to understand design intent; Methods to understand design context; Methods to understand users; Methods to frame insights; Methods to generate creative concepts; Methods to frame solutions; Methods to realize offerings; Introduction to different design toolkits.	
Books (In case UG compulsory courses, please give it as "Text books" and "Reference books". Otherwise give it as "References".	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	V. Kumar, *101 Design Methods: A Structured Approach for Driving Innovation in Your Organization,* John Wiley & Sons, 2012.
2.	E. Bonollo, *Product Design: A Course in First Principles,* Upfront Publishing, 2016.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	K. T. Ulrich and S. D. Eppinger, *Product Design and Development*, 7th Edition, McGraw Hill, 2020.
2.	R. Curedale, *Design Methods 1: 200 Ways to Apply Design Thinking*, Design Community College Inc., 2012.
3.	R. Curedale, *Design Methods 2: 200 More Ways to Apply Design Thinking,* Design Community College Inc., 2013.
4.	B. Martin and B. Hanington, *Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions*, Rockport Publishers, 2012.

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Course Number & Title: DD 544 Ergonomics in Product Design	
L-T-P-C: 2-0-2-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: MDes in Electronic Product Design	
Offered in (Odd/ Even / Any): Odd	
Offered by (Name of Department/ Center): Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): This course is concerned with users' physical and cognitive capabilities that are determinants of diverse interactions with products in an environment or usage scenario. This course would help the students conceptualize human-centric product design considering human factor issues in various phases of product design process.	
Course Content/ Syllabus Fundamental of Ergonomics: Definitions and domain of specializations (Physical, Cognitive, and Organizational Ergonomics), Ergonomics versus Human Factors, System design approach in ergonomics, Importance of Ergonomics/ Human Factors, Ergonomics in product design process. Human Capabilities and Limitations: Anthropometric, Biomechanical, Physiological, Behavioural, and Psycho-social considerations; Occupational stress and musculoskeletal disorders, Safety and health issues. Cognitive Aspects of User-system Interactions: Special senses, Information acquisition and processing (Sensation, Perception, Cognition, Attention, Memory, etc.) and Motor response, Human error, and Reliability; Ergonomics evaluation, Principles of hand-held device design, Visual ergonomics: Principles of control-display design, Readability and legibility of static and dynamic displays.	
Books (In case UG compulsory courses, please give it as "Text books" and "Reference books". Otherwise give it as "References".	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	K. H. Kroemer, *Fitting the Human: Introduction to Ergonomics/Human Factors Engineering,* CRC Press. 2017.
2.	R. Bridger, *Introduction to Human Factors and Ergonomics,* CRC press, 2017.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	R. W. Proctor, *Human Factors in Simple and Complex Systems*, 3rd Edition, CRC Press, 2022.
2.	W. Karwowski, M. M. Soares, and N. A. Stanton (Eds.), *Human Factors and Ergonomics in Consumer Product Design: Uses and Applications,* CRC Press, 2011.
3.	N. J. Stone, A. Chaparro, J. R. Keebler, B. S. Chaparro, and D. S. McConnell, *Introduction to Human Factors: Applying Psychology to Design,* CRC Press, 2017.
4.	R. T. Kellogg, *Fundamentals of Cognitive Psychology,* Sage Publications, 2015.
5.	M. M. Soares and F. Rebelo, *Ergonomics in Design: Methods and Techniques,* CRC Press, 2016.

6.	D. J. Mayhew, *The Usability Engineering Lifecycle: A Practitioner's Handbook for User Interface Design*, Morgan Kaufmann, 1999.
7.	C. Forsythe, H. Liao, M. C. S. Trumbo, and R. E.Cardona-Rivera, *Cognitive Neuroscience of Human Systems*, CRC Press, 2017.
8.	M. R. Lehto and S. J. Landry, *Introduction to Human Factors and Ergonomics for Engineers,* CRC Press, 2012.

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Course Number & Title: DD 545 Rapid Prototyping and Development	
L-T-P-C: 0-1-4-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: MDes in Electronic Product Design	
Offered in (Odd/ Even / Any): Odd	
Offered by (Name of Department/ Center): Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): The course is a practical oriented course to develop hands on skills in developing electronic products using rapid prototyping methods. Students will be taught latest prototyping platforms through tutorials and will be expected to prototype creative electronic product concepts on their own.	
Course Content/ Syllabus Introduction to Prototyping Boards: Arduino, Raspberry Pi, BeagleBoard, ESP 32 etc.; Using sensors and actuators with prototyping boards; Programming with Raspberry Pi and Arduino- intermediate and advanced programming of boards; Camera and environmental sensing; Wireless communication and networking-radio, Bluetooth and serial communication with prototyping boards; Integrating prototyping boards with digital environments; Introduction to CAD software; 3D printing for prototyping.	
Books (In case UG compulsory courses, please give it as “Text books” and “Reference books”. Otherwise give it as “References”.	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	Simon Monk, *Electronics Cookbook: Practical Electronic Recipes with Arduino and Raspberry Pi,* O'Reilly Media Inc., 2017.
2.	Matthew Scarpino, *Motors for Makers: A Guide to Steppers, Servos, and Other Electrical Machines,* Que Publishing, 2015
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	Anna Kaziunas France, *Make: 3D Printing: The Essential Guide to 3D Printers,* Maker Media Inc., 2013.
2.	Paul Horowitz and Winfield Hill, *The Art of Electronics,* 3rd Edition, Cambridge University Press, 2015.
3.	Simon Monk, *Raspberry Pi Cookbook: Software and Hardware Problems and Solutions,* O'Reilly Media Inc., 2016.
4.	Greg Borenstein, *Making Things See: 3D Vision with Kinect, Processing, Arduino, and MakerBot,* O'Reilly Media Inc., 2012.
5.	Charles Platt, *Make: Electronics: Learning Through Discovery,* O'Reilly Media Inc., 2009.
6.	Tom Igoe, *Making Things Talk: Using Sensors, Networks, and Arduino to See, Hear, and Feel Your World,* O'Reilly Media Inc., 2011.

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Course Number & Title: DD 546 Product Form and Structures	
L-T-P-C: 0-1-4-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: M.Des in Electronic Product Design	
Offered in (Odd/ Even / Any): Even	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): The course is a studio-based course to sensitize the importance of product form and expression in product design. Students will learn about the principles of product styling and get exposure to different materials to realize product forms.	
Course Content/ Syllabus Introduction: Elements of form in design (Visual elements, Relational elements and Constructional elements); Unit form; Super unit form. Principles of Form Design: Principles of three-dimensional design (Variations of the elements, Treatments of the elements, Repetition of the elements, Joining and Organizing); Gestalt principle in three-dimensional form design for products. Form in Product Design: Aesthetic form; Bios form; Cultural form; Novelty form; Expression as a basis for a new form; Lines and meanings for expression; Attractiveness and product style; Faces of attractiveness.	
Books (In case UG compulsory courses, please give it as "Textbooks" and "Reference books". Otherwise give it as "References".	
1.	W. Wong, *Principles of Three-Dimensional Design,* Van Nostrand Reinhold Company, 1977.
2.	H. G. Greet and R. R. Kostellow, *Elements of Design and the Structure of Visual Relationships*, Princeton Architectural Press, NY, 2002.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	L. Oei and C. D. Kegel, *The Elements of Design: Rediscovering Colors, Textures, Forms and Shapes*, Thames & Hudson, 2004.
2.	M. Baxter, *Product Design: A Practical Guide to Systematic Methods of New Product Development*, CRC Press, 1995.

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Course Number & Title: DD 547 Design for Environmental Sustainability	
L-T-P-C: 1-1-0-4	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: MDes in Electronic Product Design	
Offered in (Odd/ Even / Any): Even	
Offered by (Name of Department/ Center): Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): This course will introduce students on how to design products considering their entire life cycle to achieve environment-friendly manufacturing and consumption. It will equip them to perform life cycle assessment by computing the environmental performance of products, systems, and related processes.	
Course Content/ Syllabus Basics of Environmental Sustainability: Industrial ecology and dematerialization, Production-consumption system. Life Cycle Assessment: Product life cycle phases, Life cycle inventory, "Fast Track" Life cycle assessment. Life Cycle Design: Life cycle approach, Functional approach.	
Books (In case UG compulsory courses, please give it as "Text books" and "Reference books". Otherwise give it as "References".	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	J. G. Vogtländer, *LCA: A Practical Guide for Students, Designers and Business Managers*, 4 ed. Delft Academic Press (VSSD Publishers), 2012.
2.	C. A.Vezzoli, *Design for Environmental Sustainability- Life Cycle Design of Products*, 2 ed., Springer, London, 2008.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	C. A.Vezzoli and E. Manzini, *Design for Environmental Sustainability*, Springer Science & Business Media, 2008.

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Course Number & Title: DD 548 Embodiment Design	
L-T-P-C: 2-0-2-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: MDes in Electronic Product Design	
Offered in (Odd/ Even / Any): Even	
Offered by (Name of Department/ Center): Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): This course will introduce students on the key considerations for embodying an electronic product concept to make it suitable for manufacturing and production.	
Course Content/ Syllabus Principles of Embodiment Design: Product architecture development, Steps and guidelines, Product modularity; Introduction to manufacturing. Processes for Electronic Product Design: Die casting, Injection molding, Sheet metal fabrication, PCB manufacturing, Automation. Design Guidelines for Manufacturing Processes: Injection molding, Machining, Sheet metal fabrication, Die casting, Powder metallurgy. Guidelines for PCB Design: Best practices, Batch and mass production, High speed automation, Robotic assembly, EM shielding. Introduction to Electromechanical Systems: Common sensors, Transducers, Batteries and Electromechanical actuators. Practical Considerations in Implementing Control Systems: Solenoids, Motors, PWM, Encoders, Closed loop and open loop control, PID controllers, ESC controllers. Introduction to Mechanical Components: Common fasteners, springs, bearing, gears, drives, couplings and linkages. Design for X: Guidelines for aesthetics, Corrosion, Manual handling, Assembly, Disassembly. Design for Quality: Quality function deployment, FMEA, Product reliability, Standards and certification in electronic product design.	
Books (In case UG compulsory courses, please give it as “Text books” and “Reference books”. Otherwise give it as “References”.	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	G. Pahl, W. Beitz, J. Feldhusen, and K. Grote, *Engineering Design: A Systematic Approach*, 3rd Edition, Berlin, Springer, 2007.
2.	S. Eppinger and K. Ulrich, *Product Design and Development,* McGraw-Hill Higher Education, 2015.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	

1.	Geoffrey Boothroyd, Peter Dewhurst, and Winston A. Knight, *Product Design for Manufacture and Assembly,* CRC Press, 2010.
2.	William Bolton, *Mechatronics,* Pearson Education India, 2008.
3.	Robert C. Juvinall and Kurt M. Marshek, *Machine Component Design,* Wiley, 2013.
4.	Paul Horowitz and Winfield Hill, *The Art of Electronics,* 3rd Edition, Cambridge University Press, 2015.
5.	Serope Kalpakjian and Steven R. Schmid, *Manufacturing Engineering and Technology,* Pearson Education India, 2010.
6.	Rob Thompson, *Manufacturing Processes for Design Professionals*, Thames and Hudson, 2007.

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Course Number & Title: DD 549 Systems Thinking	
L-T-P-C: 1-1-0-4	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Compulsory	
Offered to: M. Des. in Electronic Product Design	
Offered in (Odd/ Even / Any): Even	
Offered by (Name of Department/ Center): Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): This course will enable participants with principles of system analysis and design. Various tools and methods for system study, system analysis, structuring system requirements will be discussed in the course. This course discusses and demonstrates the organizational process that a team of business and systems professionals use to develop and maintain computer-based information systems. It stresses the importance of responding to and anticipating problems through innovative uses of information technology. The course provides a foundation for systems development, then goes on to making the business case, analysis, design, implementation and thereby creating an innovative user experience. It provides a great resource of structured system analysis and design methods and tools for generating new ideas and strategies for success.	
Course Content/ Syllabus Foundations of system development, System development environment, Fundamentals of information systems, System development planning, System analysis – Determining system requirements, Structuring system process requirements, Context diagram, Data flow diagrams, Current physical DFD, Current logical DFD, New logical DFD and New physical DFD. Decomposition of DFDs. Brief introduction to UML, Finalizing design specifications, System implementation strategy.	
Books (In case UG compulsory courses, please give it as “Text books” and “Reference books”. Otherwise give it as “References”.	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	J. F. George and J. S. Valacich, *Modern Systems Analysis and Design*, 8th Edition, Pearson, 2016.
2.	K. Kendall and J. Kendall, *Systems Analysis and Design*, Global Edition, 10th Edition, Pearson, 2019.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	J. L. Whitten and L. D. Bentley, *Systems Analysis and Design Methods*, 7th Edition, McGraw-Hill Education, 2005.

2.	Alex Xu, *System Design Interview – An Insider's Guide*, Amazon Digital Services LLC - KDP Print US, 2020.

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Course Number & Title: DD550 Image Processing with Machine Learning	
L-T-P-C: 3-0-0-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: M. Des. in Electronic Product Design	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): This course will cover the fundamentals of image processing and introduce machine learning (ML) concepts and algorithms for image analysis. In contrast to a usual course on image processing, this course covers image processing topics and related applications using both non-ML and ML-based algorithms. Understanding image processing topics from an ML point of view will be helpful for advanced image and video processing courses.	
Course Content/ Syllabus: Fundamentals of Machine Learning: Supervised and unsupervised learning, regression and classification. Image Processing with Machine Learning: Introduction to image processing; Machine learning workflow for image processing; Elements of visual perception, imaging geometry; Image processing in spatial and frequency domains; Color image processing; Image representation and image descriptors. Application of Machine Learning in Image Analysis: Image classification and image segmentation.	
Books (In case UG compulsory courses, please give it as "Textbooks" and "Reference books". Otherwise, give it as "References".	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, 3rd Edition, Pearson Education, 2018.
2.	E. Alpaydin, *Introduction to Machine Learning*, 4th Edition, MIT Press, 2020.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	A. K. Jain, *Fundamentals of Digital Image processing*, 1st Edition, Pearson Education, 2015.
2.	C. M. Bishop, *Pattern Recognition and Machine Learning (Information Science and Statistics)*, 1st Edition, Springer, 2006.
3.	I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, MIT Press, 2016.
4.	R. O. Duda and P. E. Hart, *Pattern Classification*, 2nd Edition, John Wiley & Sons, 2007.

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Proposal for a New Course / ~~Revision of a Course~~

Course Number & Title: DD 551 Biomedical Devices	
L-T-P-C: 3-0-0-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: M. Des. in Electronic Product Design	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): This course introduces various biomedical devices used in clinics with the main focus on diagnostic imaging. Introduction to medical needs, identification of needs, and fundamentals of the needs being addressed will be covered. In addition, principles of various medical imaging modalities such as X-ray, CT, MRI, ultrasound, and optical modalities and instrumentation involved will be covered. This course is interdisciplinary in nature and is divided into three parts: biomedical physics and instrumentation, medical device design, and biomedical image analysis.	
Course Content/ Syllabus: Fundamentals: Introduction to medical needs, medical imaging, cost, applications, bioethics, radiation physics, dosimetry. Diagnostic Imaging: X-ray imaging, computed tomography, backprojection, sound propagation in tissues, ultrasound, magnetic resonance imaging (MRI), optical imaging, transducers. Medical Implants: Implant design, missing organ and replacement, bioartificial devices, material selection, regeneration of skin, biocompatibility, corrosion and wear, regulation of devices, implants for bones, dental and otologic implants. Signal and Image Analysis: Source of bioelectric potential, rhythmic excitation of heart, EEG, ECG, EMG, texture in medical images, segmentation and classification, tissue characterization in ultrasound, artificial intelligence for medical image analysis.	
Books (In case UG compulsory courses, please give it as “Textbooks” and “Reference books”. Otherwise, give it as “References”.	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	J. T. Bushberg, J. A. Seibert, E. M. Leidholdt Jr., J. M. Boone, *The Essential Physics of Medical Imaging,* Lippincott Williams & Wilkins, 2013.
2.	P. J. Ogrodnik, *Medical Device Design: Innovation from Concept to Market*, 2nd Edition, Academic Press, 2019.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	I. V. Yannas, *Tissue and Organ Regeneration in Adults: Extension of the Paradigm to Several Organs*, 2nd Edition, Springer Nature, 2015.
2.	M. Chappell, *Principles of Medical Imaging for Engineers: From Signals to Images,* Springer International Publishing, 2019.
3.	K. C. Santosh, S. Antani, D. S. Guru, and N. Dey, eds., *Medical Imaging: Artificial Intelligence, Image Recognition, and Machine Learning Techniques*, CRC Press, 2019.

4.	P. H. King, R. C. Fries, and A. T. Johnson, *Design of Biomedical Devices and Systems*, CRC Press, 2018.
5.	B. M. Achauer Ed., *Plastic Surgery: Indications, Operations, Outcomes,* Vol. 1, Mosby, 2000.
6.	R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, 4th Edition, Pearson, 2018.

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Proposal for a New Course / ~~Revision of a Course~~

Course Number & Title: DD552 Design of Embedded Systems	
L-T-P-C: 2-0-2-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: M. Des. in Electronic Product Design	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional):	
Course Content/ Syllabus: Introduction: Definition of embedded systems, examples, characteristics, design flow. Embedded System Components: Processing units (Microcontrollers, microprocessors, DSP), memories (Primary memory, secondary memory), communication, input/output (IO), analog-to-digital converter (ADC). Embedded System Software: Embedded operating systems, real time operating system (RTOS), firmware, bootloader. Embedded Memory: Read-only memory (ROM) (Masked ROM, programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM)), random-access memory (RAM) (Static random-access memory (SRAM), dynamic random access memory (DRAM), synchronous dynamic random-access memory (SDRAM)), hybrid (EEPROM, flash, non-volatile random-access memory (NVRAM)), direct memory access. Interfacing: Serial (Inter-Integrated circuit (I2C), serial peripheral interface (SPI), universal asynchronous receiver-transmitter (UART), universal serial bus (USB), recommended standard 232(RS232)), parallel, general-purpose input/output (GPIO) pins, display interface (Video graphics array (VGA), high-definition multimedia interface (HDMI)). Design Flow: Analysis of requirements, schematic, PCB, prototyping, firmware development, casing, electromagnetic interference (EMI), testing.	
Books (In case UG compulsory courses, please give it as “Textbooks” and “Reference books”. Otherwise, give it as “References”.	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	P. Marwedel, *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things*, 3rd edition, Springer, 2018.
2.	E. A. Lee and S. A. Seshia, *Introduction to Embedded Systems – A Cyber–Physical Systems Approach*, 2nd Edition, The MIT Press, 2017.

References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	J. W. Valvano, *Embedded Microcomputer Systems: Real Time Interfacing,* 3rd Edition, Cengage Learning-Engineering, 2011.
2.	D. Russell, *Introduction to Embedded Systems: Using ANSI C and the Arduino Development Environment,* Morgan & Claypool, 2010.
3.	R. Kamal, *Embedded Systems: Architecture, Programming and Design*, 3rd Edition, McGraw-Hill, 2017.
4.	S. Chattopadhyay, *Embedded System Design*, 2nd Edition, PHI Learning Private Limited, 2013.

Indian Institute of Technology Guwahati
Proposal for a New Course / ~~Revision of a Course~~

Course Number & Title: DD553 Basics of Digital Signal Processing	
L-T-P-C: 3-0-0-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: M. Des. in Electronic Product Design	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional):	
Course Content/ Syllabus: Introduction to digital signal processing (DSP), history and applications; Analog signals – single and multi-dimensional signals; Sinusoids, periodic signals and spectral representations, Fourier series and harmonics-relation to music and other signals, Fourier transforms; Sampling of analog signals – sampling theorem, quantization; Discrete-time signals – representations in time domain, representation in frequency domain – discrete-time Fourier transform (DTFT), discrete Fourier transform (DFT) and fast Fourier transform (FFT); FIR and IIR filters – special filters for noise reduction and other applications, impulse response, transfer function and pole-zero representations, frequency response, stability; Introduction to data compression – compression basics with examples of speech, audio, image and video compression, simple MATLAB programming for DSP applications.	
Books (In case UG compulsory courses, please give it as "Textbooks" and "Reference books". Otherwise, give it as "References".	
Texts: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	S. K. Mitra, *Digital Signal Processing: A Computer-Based Approach*, 4th Edition, McGraw Hill, 2013.
2.	J. H. McClellan, R. W. Schafer and M. A. Yoder, *Signal Processing First*, 2nd Edition, Pearson, 2016.
References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	John G. Proakis Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Application*, 4th Edition, Pearson, 2007.
2.	A. Spanias, "An introductory signal processing course offered across the curriculum," *2015 IEEE Signal Processing and Signal Processing Education Workshop (SP/SPE)*, 2015.
3.	K. Sayood, *An introduction to Data Compression*, 5th Edition, Elsevier, 2019.

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Proposal for a New Course / ~~Revision of a Course~~

Course Number & Title: DD554 Pattern Recognition and Machine Learning	
L-T-P-C: 3-0-0-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: M.Des in Electronic Product Design	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): The course provides fundamental aspects and a comprehensive introduction to the pattern recognition and machine learning fields. This course is ideal for postgraduate students and research scholars. It is intended to cover the basics of applied math and machine learning. Machine learning has become extremely popular in many applications such as data science, computer vision, natural language processing, medical diagnosis, and stock market trading. Thus, irrespective of the background, it is to lay the foundation to understand the research trends in different domains.	
Basics of linear algebra, optimization, probability theory, and random variables; Pattern recognition systems, supervised and unsupervised learning, classification and regression models; Least squares regression, Bayesian classifier, and discriminant functions; Maximum-likelihood and MAP estimation, principal component analysis, nearest-neighbor estimation; Perceptrons, multi-layer perceptron, feedforward operation, backpropagation algorithm, activation function, regularization; Autoencoders, CNNs, decision trees, radial basis function networks; Machine learning applications in the field of design, and case studies.	
Books (In case UG compulsory courses, please give it as “Text books” and “Reference books”. Otherwise give it as “References”.	
Texts/ References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	R. O. Duda, P. E. Hart, and D. G. Stork, *Pattern Classification*, 2nd Edition, Wiley-Interscience, 2007.
2.	C. M. Bishop, *Pattern Recognition and Machine Learning (Information Science and Statistics)*, 1st Edition, Springer, 2006.
3.	I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, MIT Press, 2016.
4.	A. Jung, *Machine Learning: The Basics*, Springer, 2022.
5.	A. C. Müller and S. Guido, *Introduction to Machine Learning with Python: A Guide for Data Scientists*, O’Reilly Media, Inc., 2016.

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Proposal for a New Course / ~~Revision of a Course~~

Course Number & Title: DD555 IoT Enabled Smart Grids	
L-T-P-C: 3-0-0-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: M. Des. in Electronic Product Design	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional): The course is designed to provide the students with an in-depth understanding of various technologies IoT-aided smart grid (SG) systems, and includes the existing architectures, applications, and prototypes of the IoT-aided SG systems. The course also highlights open issues and challenges in IoT-aided SG systems. The course is divided into three parts. The first part introduces the technologies related to smart grid and IoT, the second part details with the integration of smart grids and IoT, and the third part deals with testbeds, prototypes, and associated challenges of IoT enabled smart grids.	
Course Content/ Syllabus: Introduction to Smart Grids and IoT: Existing grid architecture, smart grid technologies, power converters, measurement devices. Integration of Smart Grids and IoT: Existing applications of IoT in smart grids, architectures for IoT enabled smart grid, communication technologies, standards and interoperability. Current Applications and Challenges: Big data applications, security challenges, existing testbeds and prototypes, internet of energy.	
Books (In case UG compulsory courses, please give it as “Textbooks” and “Reference books”. Otherwise, give it as “References”.	
Texts/ References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	J. A. Momoh, *Smart Grid: Fundamentals of Design and Analysis*, John Wiley & Sons, 2012.
2.	A. Keyhani, Design of Smart Power Grid Renewable Energy Systems, John Wiley & Sons, 2016.
3.	E. Kabalci and Y. Kabalci, *From Smart Grid to Internet of Energy*, Academic Press, 2019.
4.	J. Ekanayake, N. Jenkins, K. Liyanage, J. Wu and A. Yokoyama, *Smart Grid: Technology and Applications*, John Wiley & Sons, 2012.
5.	K. Siozios, D. Anagnostos, D. Soudris, E. Kosmatopoulos, *IoT for Smart Grids: Design Challenges and Paradigms*, Springer, 2019.
6.	N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications, and Design*, John Wiley & Sons, 2003.
7.	T. Sato, D. M. Kammen, B. Duan, M. Macuha, Z. Zhou, J. Wu, M. Tariq, S. A. *Asfaw, Smart Grid Standards: Specifications, Requirements, and Technologies*, John Wiley & Sons, 2015.

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Proposal for a New Course / ~~Revision of a Course~~

Course Number & Title: DD556 Bio Signals in Medical Device Design	
L-T-P-C: 2-0-2-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: M. Des. in Electronic Product Design	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisite: None	
Preamble / Objectives (Optional):	
Course Content/ Syllabus: Introduction to Biomedical Signals: Classification of biomedical signals, sources of bioelectric potential, resting membrane potential, action potential, propagation of action potentials in nerves. Cardiovascular Signals: Rhythmic excitation of heart, electrocardiogram (ECG), heart rate and variability. Electroencephalogram (EEG): Neural basis of the EEG, EEG rhythms, beta wave, alpha wave, theta wave, delta wave, evoked potential, event related potential. Electromyography (EMG): Nerve conduction and electromyography, surface EMG. Biomedical signals of non-electrical origin: Photoplethysmography, phonocardiogram, seismocardiography, speech signals. Biomedical Signal Processing: Sensors for biomedical signals, pre-processing of biomedical signals, filtering of signals (electrical origin and non-electrical origin), data acquisition, morphological studies and rhythm analysis, application of embedded system for biomedical signals, ergonomics in biomedical sensor and system design. Machine Learning for Diagnosis: K-nearest neighbours and K-means clustering, vector quantization, Bayes classifier.	
Books (In case UG compulsory courses, please give it as “Textbooks” and “Reference books”. Otherwise, give it as “References”.	
Texts/ References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	R. M. Rangayyan, *Biomedical Signal Analysis*, 2nd Edition, Wiley-IEEE Press, 2016.
2.	D. Prutchi and M. Norris, *Design and Development of Medical Electronic Instrumentation*, John Wiley and Sons, 2005.
3.	J. G. Webster, A. J. Nimunkar, *Medical Instrumentation: Application and Design*, 5th Edition, John Wiley and Sons, 2020.
4.	V. Oppenheim, A. S. Willsky, and H. S. Nawab, *Signals and Systems*, 2nd Edition, Pearson, 2015.
5.	E. N. Bruce, *Biomedical Signal Processing and Signal Modelling*, John Wiley and Sons, 2001.
6.	W. J. Tompkins, *Biomedical Signal Processing*, Prentice Hall, 1995.

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Proposal for a New Course / ~~Revision of a Course~~

Course Number & Title: DD 557 Fundamentals of Sensors and their Applications	
L-T-P-C: 3-0-0-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular Letter Grades	
Kind of Proposal (New Course / Revision of Existing Course): New Course	
Offered as (Compulsory / Elective): Elective	
Offered to: B.Tech (final year), M.Des in Electronic Product Design, PhD	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Department of Design	
Pre-Requisites: None	
Preamble / Objectives (Optional): The objective of the course is to sensitize students to different modern sensors available in the market and to develop a basic understanding of these sensors for various applications.	
Course Content/ Syllabus: Classification of sensors, sensor characteristics, principles of sensing, introduction to the following sensors and their applications; Motion sensors, position and displacement sensors; Velocity and acceleration sensors; Force, strain and tactile sensors; Pressure and flow sensors; Acoustic sensors; Humidity sensors; Light sensors; Temperature sensors; Gas and chemical sensors.	
Texts/ References: (Format: Authors, *Book Title in Italics font,* Volume/Series, Edition Number, Publisher, Year.)	
1.	V. K. Khanna, *Nanosensors*, 2nd Edition, CRC Press, 2021.
2.	S. Nihtianov and A. Luque, *Smart Sensors and MEMS*, 2nd Edition, Springer, 2018.
3.	G. R. Sinha, *Advances in Modern Sensors*, 1st Edition, IOP Publishers, 2020.
4.	J. Vetelino and A. Reghu, *Introduction to Sensors*, 1st Edition, CRC Press, 2011.
5.	W. Lang, *Sensors and Measurement Systems*, 2nd Edition, River Publishers, 2021.
6.	E. G. Bakhoum, *Micro- and Nano-Scale Sensors and Transducers*, 1st Edition, Taylor & Francis, 2019.