M. Des. Electronic Systems (EDS)

(According to 34th Senate meeting minutes)

<table>
<tr><td>Course Title</td><td>Concepts of Product Design and Development</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Mechanical Engineering</td><td>Structure (IPC)</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Offered for</td><td>M. Des.</td><td>Status (Core / Elective)</td><td colspan="3">Core</td></tr>
<tr><td>Prerequisite</td><td>----</td><td>To take effect from</td><td colspan="3"></td></tr>
<tr><td>Course Objectives</td><td colspan="5">1. The course comprises theoretical sessions that are supplemented with practice sessions.
2. The students will be given an overview of systematic approach used during product design and development.
3. The course will highlight the methods for need identification, techniques for creative thinking, concept generation, concept selection, product architecture, aesthetics, ergonomics etc.
4. The students will realize the design through models of using suitable materials.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">1. The students will be able to understand the need of a customer and use the creative thinking to conceptualize designs.
2. The students will also be able to quickly visualize the concepts using models.</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Theory:
Introduction: Importance of engineering design, types of design, total life cycle- types of products, Phases of product development process, product and process cycles. (4)
Problem Definition & Need Identification: Identifying customer needs, gathering information classifying customer requirements, engineering characteristics, competitive benchmarking, QFD, product design specification. (6)
Conceptual Design: Creativity in design, creativity and problem solving, creative thinking methods, conceptual decomposition morphological methods-TRIZ and contradiction, Bio and Shape mimicry techniques, Decision making and concept selection-decision theories-concept screening and scoring. (8)
Embodiment Design: Product architecture, steps in developing product architecture, industrial design human factors design, Nostalgia and Design, Environment factors. (8)
Design Profile Preparation (2)
Practice:
Method of Expressing and communicating and documenting technical ideas through sketches (1)
Clay, Foam, Wood modeling and modern 3D printing (2)
Problem Definition and Need Identification (1)
Conceptual design : Morphological charts, TRIZ and Contradiction, Bio and Shape mimicry, Concept selection, Screening (5)
Embodiment Design : Product Architecture, Human Factors, Aesthetics, Nostalgia and Environmental factors (4)
Design Profile presentation (1)</td></tr>
<tr><td>Textbooks</td><td colspan="5">1. K. Otto, Product Design, Pearson Education, 1st edition, 2011, ISBN: 8177588214.
2. U. Karl and S. Eppinger, Product Design and Development, McGraw-Hill Education, 6th edition, 2015, ISBN: 0078029066.</td></tr>
<tr><td>References</td><td colspan="5">1. C. A. Harper, Handbook of Materials for Product Design, McGraw-Hill Professional, 1st edition, 2001, ISBN: 0071354069.
2. R. Stuer and K. Eissen, Sketching: Drawing Techniques for Product Designers, Thames & Hudson, 1st edition, 2007, ISBN: 9063691718.
3. B. Hallgrimsson, Prototyping and Modelmaking for Product Design, Laurence King Publishing, 1st edition, 2012, ISBN: 9781856698764.</td></tr>
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Course Title	Analog IC Design	Course No	To be filled by the office		
Specialization	Computer Engineering	Structure (IPC)	3	0	3
Offered for	M. Des. (EDS), DD (EVD)	Status (Core / Elective)	Core		
Prerequisite	Electromagnetic Theory	To take effect from			
Course Objectives	To impart in depth knowledge in CMOS based analog circuits, performance metrics, design and analysis of operational amplifiers and transconductor amplifiers.				
Course Outcomes	Students would be able to design and analyze complex analog integrated circuits using industry level analog IC Design tools				
Contents of the course	Components and mismatch in CMOS process, models and Layout techniques. (3) MOS Transistor: Layout, model, Body effect, transit frequency. (3) Noise: Noise in Resistor, capacitor, and MOSFET, spectral density; noise, offset, swing limits and slew rate in single stage opamp. (8) Cascode current mirror, and Negative feedback amplifiers. (5) Cascade, Folded cacscode multi stage and Miller compensated op amps. (8) Fully differential circuits and opamp, common mode feedback circuits. (6) Loop gain and stability, PLL. (5) Voltage reference and regulator circuits. (4)				
Textbooks	1. B. Razavi, Design of Analog CMOS Integrated Circuits, 2nd edition McGraw-Hill Education, 2016, ISBN: 978-0-07-252493-2.				
References	1. T. C. Carusone, D. A. Johns and K. W. Martin, Analog Integrated Circuit Design, John Wiley & Sons, Inc., 2012, ISBN: 978-0-470-77010-8. 2. P. R. Gray, P. J. Hurst, S. H. Lewis and R. G. Meyer, Analysis And Design Of Analog Integrated Circuits, 5th edition, John Wiley & Sons, Inc., 2009. ISBN: 978-0-470-24599-6. 3. T. Ndjountche, CMOS Analog Integrated Circuits High-Speed And Power-Efficient Design, CRC Press Taylor & Francis Group, 2011. ISBN: r-13: 978-1-4398-5500-3.				

Course Title	Electromagnetic Interference and Compatibility	Course No	To be filled by the office		
Specialization	Electronics Engineering	Structure (IPC)	3	3	5
Offered for	M. Des. (EDS), DD (EVD)	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	1. To learn the various sources of Electromagnetic Interference. 2. To familiarize the fundamentals those are essential for product design with EMC compliance. 3. To understand the various EMC pre compliance measurement.				
Course Outcomes	1. The students would gain knowledge to understand the concept of EMI / EMC related to product design. 2. The students will have broad knowledge of various aspects of EMC and its standards. 3. The students can diagnose and solve various electromagnetic compatibility problems. 4. The students will able to understand the sources of EMI and various coupling methods. 5. The students can learn the various method of doing the pre compliance measurement techniques				
Contents of the course	**Theory:** Introduction to EMI and EMC- Various EMC requirements and standards-Need for EMC and its importance in electronic product design - sources of EMI - few case studies on EMC. (8) Conducted and radiated emission -power supply line filters-common mode and differential mode current-common mode choke- switched mode power supplies. (4) Shielding techniques- shielding effectiveness-shield behavior for electric and magnetic field - aperture-seams-conductive gaskets- conductive coatings (6) Grounding techniques- signal ground-single point and multi point grounding-system ground-common impedance coupling -common mode choke-Digital circuit power distribution and grounding. (8) Contact protection - arc and glow discharge-contact protection network for inductive loads-C, RC, RCD protection circuit- inductive kick back. (4) RF and transient immunity-transient protection network- RFI mitigation filter-power line disturbance- ESD- human body model- ESD protection in system design. (5) PCB design for EMC compliance-PCB layout and stack up- multi layer PCB objectives-Return path discontinuities-mixed signal PCB layout. (4) EMC pre compliance measurement-conducted and radiated emission test-LISN-Anechoic chamber. (3) **Practice:** Familiarization of various EMC pre-compliance tests, Study of induced voltages and Pick up, demonstration of cross talk in cables, Ground noise in digital logic, Measurement of conducted emission using LISN, Measurement of radiated emission, Susceptibility test of various electronic equipment.				
Textbooks	1. H. W. Ott, Electromagnetic Compatibility Engineering, 2nd edition, John Wiley & Sons, 2011, ISBN: 9781118210659. 2. C. R. Paul, Introduction to Electromagnetic Compatibility, 2nd edition, Wiley India, 2010, ISBN: 9788126528752.				
References	1. K. L. Kaiser, Electromagnetic Compatibility Handbook, 1st edition, CRC Press, 2005. ISBN: 9780849320873.				

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<tr><td>Course Title</td><td>Embedded Systems Design</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Electronics Engineering</td><td>Structure (IPC)</td><td>3</td><td>3</td><td>5</td></tr>
<tr><td>Offered for</td><td>M. Des. (EDS)</td><td>Status (Core / Elective)</td><td colspan="3">Core</td></tr>
<tr><td>Prerequisite</td><td>Basic familiarity with circuits and electronics, C programming, and microprocessor organization</td><td>To take effect from</td><td colspan="3"></td></tr>
<tr><td>Course Objectives</td><td colspan="5">To provide a hands-on introduction to design of embedded systems hardware and software, and interfacing in real-time to networked cyber-physical systems.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">1. Understand the basic elements of embedded systems such as I/O and interfaces
2. Understand embedded system design using the ARM Cortex-M microcontroller with the Launchpad IDE in C
3. Rapid prototyping of embedded systems using open source microcontrollers and microcomputers
4. Introduction to advanced concepts such as networking and wireless communications, real-time operating systems and control, and Internet of Things
5. Hands-on laboratory experiments and team projects involving the above concepts.</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Theory:
Introduction: history and trends; Overview of microcontrollers (2)
Elements of embedded systems such as GPIO, communication, interrupts, ADC, and DAC (8)
Implementation of embedded systems: architecture, logic, timing, protocols, and software (10)
Embedded systems design using ARM Cortex-M TM4C Launchpad IDE, and projects with sound, video games, and mobile robots (8)
Introduction to advanced concepts such as real-time interfacing and operating systems (5)
Rapid prototyping of embedded systems with TM4C and advanced boards, open source hardware, IOT systems design using Intel kits (5)
Demonstrations of embedded systems (4)
Practice:
Tiva LaunchPad and TM4C microcontroller setup and Parallel I/O: LEDs and switches. (1)
Systick timer and interrupts (2)
LCD with UART communication (1)
Digital to Analog Conversion and sound (1)
Analog to Digital Conversion (1)
Mid-semester lab examination (1)
Final lab examination (1)
Remaining sessions will be devoted to complete embedded system design (video game and mobile robot competition), projects, reviews and presentations.</td></tr>
<tr><td>Textbooks</td><td colspan="5">1. J. W. Valavano, Embedded Systems: Introduction to Arm Cortex-M Microcontrollers, 2nd edition, Create Space, 2012. ISBN: 978-1477508992.</td></tr>
<tr><td>References</td><td colspan="5">1. J. W. Valavano, Embedded Systems (Vol-2): Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2nd edition, Create Space, 2011, ISBN: 978-1463590154.
2. J. W. Valavano, Embedded Systems (Vol-3): Real-Time Operating Systems for Arm Cortex M Microcontrollers, 2nd edition, Create Space, 2012. ISBN: 978-1466468863.
3. A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013. ISBN: 978-8126556861.</td></tr>
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Course Title	Quality and Reliability based Design	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	2	3	4
Offered for	M. Des.	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	The course aims to provide an in-depth coverage of Statistical Quality control and Reliability Engineering.				
Course Outcomes	Students will be exposed to various aspects such as Control Charts, Statistical tools, basics of reliability, maintainability, etc. The course would equip students with skills required for effective Design based on Quality and Reliability Concepts.				
Contents of the course	**Theory:** Introduction: Introduction to Statistical techniques, Basics of Quality control, Quality Assurance and Cost Process Control: Statistical Tools, Causes of Variations, Control Charts for Variables and Attributes Design for Quality: Quality Loss Function, Quality Function Deployment, Fault Tree Analysis, Failure Mode and Effect Analysis. Life Data Analysis: Data collection – Non Parametric methods: Ungrouped/Grouped, Complete/Censored data-Time of failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests Reliability Engineering: Reliabilty analysis, Reliabilty Prediction, Load- Strength Analysis, Reliability Testing, Modeling and Reliability Analysis of Multi state systems. Reliability Improvement: Analysis of Downtime, Repair time Distributions **Practice:** Exercise on Control Charts for Variables and Attributes Case Study on FTA and FMEA Case study on Quality Function Deployment Exercise on reliability concepts and calculations of MTBF and MTTF Exercise on reliability prediction model.				
Textbooks	1. C. E. Ebeling, An introduction to Reliability and Maintainability engineering, Tata Mc Graw Hill, 2000. 2. A. Mitra, Fundamentals of Quality control and Improvement, 4th edition, John Wiley & Sons, 2016				
References	1. D. C. Montgomery, Introduction to Statistical Quality Control, 2nd edition, John Wiley & Sons, 1991.				

Course Title	Digital IC Design	Course No	To be filled by the office		
Specialization	Electronics Engineering	Structure (IPC)	3	3	5
Offered for	M. Des. (EDS)	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	To impart in depth knowledge in CMOS digital circuits, performance metrics, design procedures for complex combinational and sequential circuits and subsystems.				
Course Outcomes	Students would be able to design and analyze complex digital integrated circuits using semicustom and full custom design procedures.				
Contents of the course	**Theory:** Issues in Digital Integrated Circuit Design. (1) Fabrication of CMOS IC and packaging. (4) MOS Device: Threshold Voltage, Secondary Effects, SPICE Models. (4) Interconnect: Parameters, Electrical Wire Models, SPICE Wire Models. (2) CMOS Inverter: Transfer Characteristics, Noise margin, Capacitances, Propagation Delay, Power. (5) Combinational Logic Circuits: Static CMOS, Pass-Transistors, Dynamic CMOS, Dynamic Logic, Cascading. (7) Sequential Logic Circuits: Timing Metrics, Static and Dynamic Latches, Registers, C^2MOS, NORA-CMOS. (7) Arithmetic Building Blocks: Datapaths in Digital Processor Architectures. (7) Memory and Array Structures: ROM, RAM, CAM, Peripheral Circuitry, PLA and Flash Memory. (5) **Practice:** Design of various analog building blocks Schematic and layout simulation of analog ICs using Cadence and Synopsys tools Design of digital building blocks Schematic and layout simulation of digital blocks using Cadence and Synopsys tools				
Textbooks	1. J. M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits, 2nd edition, Pearson, 2003. ISBN-10: 0130909963, ISBN-13: 978-0130909961 2. B. Razavi, Design of Analog CMOS Integrated Circuits, 2nd edition McGraw-Hill Education, 2016, ISBN: 978-0-07-252493-2				
References	1. J. E. Ayers, Digital Integrated Circuits: Analysis and Design, 2nd edition, CRC Press, 2009. ISBN-10: 142006987X, ISBN-13: 978-1420069877. 2. R. J. Baker, CMOS Circuit Design, Layout, and Simulation, 3rd edition, Wiley-Blackwell, 2010. ISBN-10: 0470881321, ISBN-13: 978-0470881323. 3. T. C. Carusone, D. A. Johns and K. W. Martin, Analog Integrated Circuit Design, John Wiley & Sons, Inc., 2012, ISBN: 978-0-470-77010-8. 4. P. R. Gray, P. J. Hurst, S. H. Lewis and R. G. Meyer, Analysis And Design Of Analog Integrated Circuits, 5th edition, John Wiley & Sons, Inc., 2009. ISBN: 978-0-470-24599-6. 5. S. Kang, Y. Leblebici and C. Kim, CMOS Digital Integrated Circuits Analysis & Design, 4th edition, McGraw-Hill Higher Education, 2014. ISBN-10: 0073380628, ISBN-13: 978-0073380629. 6. R. Mehler, Digital Integrated Circuit Design Using Verilog and System Verilog, 1st edition, Newnes, 2015. ISBN: 978-0-12-408059-1				