CURRICULUM AND SYLLABUS OF
M.TECH. DEGREE PROGRAMME IN
ELECTRONICS DESIGN AND TECHNOLOGY

(Applicable from 2010 admission)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

तमसो मा ज्योतिर्गमय

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

National Institute of Technology Calicut

Vision of the Department of Electronics and Communication Engineering:

The Department of Electronics and Communication Engineering is envisioned to be a leading centre of higher learning with academic excellence in the field of electronics and communication engineering.

Mission of the Department in pursuance of its vision:

The mission of the Department of Electronics and Communication Engineering is to impart high quality technical education by offering undergraduate, graduate and research programs in the domain of Electronics and Communication Engineering with thorough foundation in theory along with strong hands-on design and laboratory components, tools and skills necessary for the students o become successful major contributors to society and profession.

PEOs and Programme Outcomes: PG Electronics Design and Technology

Programme Educational Objectives (PEOs):

Sl. No.	Program Educational Objectives
PEO 1	To produce graduates who have a solid foundation in electronics engineering fundamentals including hardware ,software and mathematics and make them competent to apply this knowledge in their chosen career in the electronics design industry.
PEO 2	To ensure that graduates will be proficient in analyzing real life problems with high sensitivity to the needs of society , and provide solutions which are economically and socially feasible.
PEO 3	To produce graduates who have the necessary competence and innovative skills to be an effective part of the research field of electronics design and development .
PEO 4	To produce graduates who are adequately motivated to continue in their chosen field and build greater technical knowledge and develop higher skills as technology advances and changes.

Programme Outcomes (POs)

The student who completes the Master of Technology in Telecommunication will have:

Sl. No.	Program Outcome	Graduate Attribute
PO 1	Develop the ability to understand clearly the steps in designing electronic systems which are in tune with current technology and adaptable for future changes in technology.	Scholarship of Knowledge
PO 2	Understand the mathematical basis on which design and development is based and which can be used in higher research.	Critical Thinking
PO 3	Understand the economic and social basis for product design based on social ,cultural and environmental factors.	Problem Solving
PO 4	Learn to look for new ideas using surveys and studies which will lead to research and development using the latest methods and methodologies.	Research Skill
PO 5	Learn to use the engineering software, hardware , design and modeling techniques that are the latest in the field of design.	Usage of Modern Tools
PO 6	Develop the ability to work as part of a team in multi disciplinary projects so as to develop a rational and scientific approach to solving problems.	Collaborative and Multidisciplinary Work
PO 7	Develop project management skills including an understanding of finance and human resource aspects.	Project Management and Finance
PO 8	Develop writing ,presentation and documentation skills which will be needed to communicate effectively with design and testing teams.	Communication
PO 9	Develop leadership talents and independent thinking and carry it throughout life with strong commitment to improve on it.	Life-long Learning
PO 10	Develop a keen sense of ethics and uncorrupted professionalism.	Ethical Practices and Social Responsibility
PO 11	Develop the capacity to re-organize and re-think design and management strategies based on the outcome of projects completed.	Independent and Reflective Learning

Department of Electronics & Communication Engineering
Curriculum for M. Tech. in Electronics Design & Technology

Semester 1

S.No	Code	Title	L	T	P/S	C
1	EC6101	Digital System Design	3	0	3	4
2	EC6102	Embedded System Design	3	0	3	4
3	EC6201	Basics of VLSI	3	0	3	4
4	EC6103	Analog and Data Conversion Systems	4	0	0	4
5		Elective 1	3	0	0	3
		Total credits				19

Semester 2

S.No	Code	Title	L	T	P/S	C
1	EC6104	DSP system design	3	0	0	3
2	EC6105	Electromagnetic compatibility	4	0	0	4
3	EC6106	Electronics System Design Lab	0	0	3	2
4	EC6107	DSP Lab	0	0	3	2
5	EC6108	Seminar	0	0	2	1
		Elective2	3	0	0	3
		Elective3	3	0	0	3
		Elective4	3	0	0	3
		Total credits				21

Semester 3

S.No	Code	Title	L	T	P/S	C
1	EC7101	Project Work	-	-	-	8
		Total credits				8

Semester 4

S.No.	Code	Title	L	T	P/S	C
1	EC7102	Project Work	-	-	-	12
		Total credits				12

Minimum Requirements

1. **Minimum number of credits to be earned by a student is 60**

List of Electives

S.No.	Code	Title	Credit
1	EC6121	Electronics Packaging	3
2	EC6122	Control System Design	3
3	EC6123	Electronic Instrumentation	3
4	EC6124	Biomedical Instrumentation	3
5	EC6125	High Speed Digital Design	3
6	EC6126	Real Time Operating Systems	3
7	EC6127	Design for Manufacturability	3
8	EC6128	Advanced Processor Architectures	3
9	EC6129	Analog and Digital Filter Design	3
10	EC6130	Hardware Software co design	3
11	EC6131	Advanced Circuit Analysis	3

- Any other subject (core/elective) offered by the Department from time to time shall be taken as elective with the consent of course co-ordinator/faculty.

Brief Syllabi

EC6101: Digital System Design

Pre-requisite: Nil

L	T	P	C
3	0	3	4

Total Hours: 42Hrs Theory + 42 Hrs Lab

Hardware Description Languages-Introduction to VHDL/VERILOG –behavioral models, structural models, test benches, Subprogram Overloading - VHDL synthesis - Design Examples-–new developments in HDLs. Finite State machines: Design of finite state machines –state tables –state graphs, Synchronizer Failure and Metastability:Synchronizer failure, Metastability Resolution Time,Timing hazards : Static Hazards, Finding static hazards, Dynamic Hazards, Designing hazard free circuit, Programmable LSI Techniques - Programmable Logic Arrays, CPLDs and FPGAs, Design For Testability Introduction to Testing and Diagnosis Fault modelling, Design for Testability, Built in Self Test, Compression Techniques

EC6102: Embedded System Design

Pre-requisite: Nil

L	T	P	C
3	0	3	4

Total Hrs: 42 Theory + 42 Hrs Lab

Introduction to Embedded system, Embedded system examples, Parts of Embedded System - Simple interfacing exampls. Memory Technologies Concept of System on chip.Details of Cypress Programmable System on Chip (PsoC), Design usind PSoC, Details of ARM processor, System Development using ARM,Digital Signal Processing on ARM, Embedded System product Development Life cycle (EDLC), Product enclosure Design and Development. Concept of firmware, operating system and application programs. Power supply Design. External Interfaces. Embeded System Development Environment, Hardware Debugging, Bus architectures.

EC6103: Analog & Data Conversion Systems

Pre-requisite: An Undergraduate course on Linear Integrated Circuits

L	T	P	C
4	0	0	4

Total Hours : 56Hrs.

Linear op-amp circuits – voltage & current amplifiers/converters instrumentation amplifier – offset compensation – noise - First and Second order filters Low input offset and low noise opamps - amplifier input and output errors - Signal conditioners with instrumentation auto-zero/chopper/isolation/charge amplifiers – THA - Analog Multiplexers Digital to analog and Analog to Digital converters – specifications and errors of DACs and ADCs - Typical ADCs and DACs -ADCs and DACs for DSP Applications - Design of DAS Understanding and interpreting data sheets and specifications - over voltage effects - Selection of amplifiers for data converters – Analog Signal handling for high speed and accuracy - Error budget considerations - Testing of Data Converters – Applications

EC6104: DSP System Design

Pre-requisite: A course on Digital Signal Processing

L	T	P	C
3	0	0	3

Total Hours: 42Hrs.

Need for Special Digital Signal Processors, Processor trends, Introduction to a popular DSP from Texas Instruments – Architectural Details - Programming - Code Composer Studio - Digital Signal Processing Applications - Current Trends in Digital Signal Processors / DSP Controllers - Other digital signal processors and architectural trends – DSP Applications.

EC6105: Electromagnetic Compatibility

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56Hrs.

Need of Electromagnetic compatibility, CE,CS,RE,RS, Noise Path, Noise Coupling,Decibels and Common EMC Units, Electrical Dimensions and Waves, Practical Experiences and Concerns, Non-ideal behaviour of electronic components, EMC Regulations, Measurement**s,** LISN. Capacitive and inductive coupling, shielding, cabling, Grounding,Common Mode Choke,Power Supplies Power supply Filters, Fields and shielding ,Electrical Bonding, EMC Components, Digital Circuit Noise and layout,Transmission lines, reflections and termination, System Design for EMC Electrostatic Discharge (ESD) - Generation, Model, Discharge,Protection ESD versus EMC, ESD Testing

EC6106: Electronic System Design Laboratory

Pre-requisite: Nil

L	T	P	C
0	0	3	2

Total Hours: 42Hrs

This lab contains the design of a complete Electronic system, which takes the student through all the steps of an electronic product.

EC6107: DSP Lab

Pre-requisite: Nil

L	T	P	C
0	0	3	2

Total Hours: 42Hrs

Introduction to C-based Embedded Design Using Code Composer Studio, and the TI 6713 DSK: Design of Filter in CCS Using C: Fourier Transform:

Implementation of the time constrained functions using assembly code, Comparison of implementation of functions using C and assembly.

Interfacing of multimedia data to the 6713 DSK, Real-Time Processing.

EC6121: Electronic Packaging

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours: 42Hrs

Functions of an Electronic Package, Packaging Hierarchy, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Material for high-density interconnect substrates, Electrical Anatomy of Systems Packaging, Design Process,Processing Technologies, Design for Reliability, IC Assembly, Discrete, Integrated and Embedded Passives, Printed Circuit Boards Board Assembly Thermal Management for IC and PWBs, Electrical Testing, Design for Testability.

EC6122: Control System Design

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours: 42Hrs

Review of basic elements of analog control systems- classical control techniques –transfer function approach- PID controller design - State-Space Models - Controllability and state transfer - Observability and state estimation - Pole Placement– State feedback approach - Digital control systems - pulse transfer function and analysis of digital control systems - Cascade and feedback compensation from continuous data controllers- Dead beat controller design - Digital controllers - Root locus, Bode plot, Nyquist plot methods- Design of Digital PID controller – state space analysis of digital control systems - Observer-based controllers - Controller realization structures - Effects of finite word length on controllability and closed loop pole placement- Case studies

EC6123: Electronic Instrumentation

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours: 42 Hrs

General principles of measurements, Transducers Basics, various types responses and analysis**,** Resistance transducers, Inductive transducers, Capacitance transducers, Temperature measurement, Piezoelectric transducers and its applications, Measurement of voltage, current, power, noise, resistance, capacitance, inductance, time, frequency, charge pulse energy, Review of Instrumentation amplifiers, Logarithmic amplifiers and their applications. Operating principles of Digital Multimeter, Ground Loop, Electromagnetic and Static pick up, Interference, Shielding and grounding, Floating Voltage measurements, Common Signals and their effect, Display systems etc. Introduction to medical instrumentation, PLC and SCADA systems.

EC6124: Biomedical Instrumentation

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours : 42Hrs.

Introduction to the physiology of cardiac, nervous & muscular and respiratory systems- Transducers and Electrodes - The heart & the other cardiovascular systems Respiratory Mechanism- Measurement of gas volumes & flow rate - Respiratory controllers - Electroencephalograph, Electromyograph,Audiometers Heamodyalisis machines – measurement of blood parameters - polarographic measurements X-ray machines, Digital Radiography, CT, MRI, ultrasound imaging, Nuclear Imaging

EC6125: High Speed Digital Design

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hrs:42Hrs

Frequency, time and distance ,High seed properties of logic gates, Modelling of wires, transmission lines, Power supply network, bypass capacitors, power supply isolation, Noise sources in digital system, Signalling modes for transmission lines, signalling over lumped transmission media,bi-directional signalling, timing properties of clocked storage elements, open loop and closed loop timing, clock distribution, synchronisation, PLL and DLL based clock aligners

EC6126: Real Time Operating Systems

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours: 42 Hrs

Introduction to Operating Systems, Examples for embedded systems Design issues and trends**,** Task Models and Metrics :Processes and tasks, various states of a task- multithreading, Real-time tasks and scheduling, Resource Access Protocols: Task Communications-Task Synchronisation, structure of RTOS and kernel design issues-Examples of typical real time operating systems

EC6127: Design For Manufacturability

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours : 42Hrs.

Product Life cycle,Need of DFM,DFM techniques, Development of DFM rules, Design Guidelines, PCB Design and manufacturing process. Design considerations for different types of PCBs,Design considerations for PCBs for different applications, Layout rules and parameters, Design rule checks, Manual verification Automated processes, Through Hole vs SMT technologies. Miniaturization and increased complexity of VLSI circuits, Yield and Yield Loss modules, Yield Analysis, Redundancy in the design, Fault Tolerant vias, layout compaction, wafer mapping optimization, planarity fill, statistical timing, DFM softwares ,Case Studies, Emerging manufactruiring trends, Certifications. Over view of Design for Testbility, Design for Assembly, Design for serviceability, Design for reliability.

EC6128: Advanced Processor Architectures

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours: 42 Hrs

Technology trend -performance measurement- History of the x86 family - Instruction Set architecture of a typical advanced x86 processor, 80386 to Pentium- Enhancements of 80386- The Enhanced Features of 80486-Latest trends, Instruction level parallelism - Instruction level parallelism and concepts- Multithreading using ILP support to exploit thread level parallelism- putting it all together, Multiprocessor and thread level parallelism- Classification of parallel architecture- -Symmetric shared memory architecture-simultaneous thread level parallelism- putting it all together in the Sun T1 processor, Pipelining: Issues and solutions

EC6129: Analog and Digital Filter Design

Pre-requisite: An undergraduate course on Signals and systems

L	T	P	C
3	0	0	3

Total Hours : 42Hrs.

Filter approximations - Butterworth, Chebychev, Bessel and Elliptic - Frequency transformations - Delay equalizer - Sensitivity RC-Op-Amp circuits, Biquad circuits – gyrator filters -   Effects of real Op-Amps – compensation - Higher order filters - Selection of components - input dynamic range and output SNR considerations Mapping of differentials – IIR filter deisgn - spectral transformations for digital filters. Design techniques for linear phase FIR filters Truncation,rounding, coefficient quantization and its effects in digital filters- scaling for parallel and cascade forms, limit-cycle oscillations, state-space structures, error spectrum shaping via feedback.

EC6130 Hardware Software Co-Design

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hrs: 42 Hrs

Review of Embedded system Design concepts, Overview of Hardware software co design framework. Components of co-design process, Models and representations, Synchronous Languages, Overview of ESTEREL Language, Modeling, Synthesis, Interfacing hardware and software, scheduling specific parts, schedule validation, Verification Interfacing to external hardware and software, Design Examples, Industry approaches to hardware software co-design

EC6131: Advanced Circuit Analysis

Pre-requisite: An undergraduate course on Electric Circuit Analysis

L	T	P	C
3	0	0	3

Total Hrs: 42 Hrs

Network topology: Matrices associated with graphs, the short circuit and open circuit operations, Theorems of Tellegen and Minty, The Implicit Duality Theorem, Multi port decomposition, ideal transformer resulting from the connection of ideal transformers, adjoint networks and systems, networks with decomposition methods based on altering network topology, Ideal components, Linear Quadratic Programming.

Detailed Syllabi

EC6101: Digital System Design

Pre-requisite: Nil

L	T	P	C
3	0	3	4

Course Outcomes:

- ***CO1**: Familiarize with the needs of special digital signal processors.*
- ***CO2**: Obtain basic knowledge about the DSP processor architectures.*
- ***CO3**: Learn the design aspects of various DSP processors using different software tools.*
- ***CO4**: Acquire the current trends in digital signal processors with examples.*

Total Hours: 42 Hrs Theory + 42 Hrs Lab

Module 1: Hardware Description Languages (14 hours)

Introduction to VHDL/VERILOG - Behavioral Modeling - Transport vs Inertial Delay - Simulation Deltas - Sequential Processing - Process Statement - Signal Assignment vs Variable Assignment - Sequential Statements - Data Types - Assert and report statements Subprograms and Packages - Predefined Attributes - Configurations - Subprogram Overloading - VHDL synthesis - Design Examples-–new developments in HDLs

Module 2: (12 hours)

Finite State machines: Design of finite state machines –state tables –state graphs – General models for sequential networks - Derivations of State Graphs and Tables

Reduction of state Tables State Assignment - Sequential Network Design

Design examples using the FSM approach –sequence detector, serial adders, multipliers, dividers.
Design using ASM charts –realization of SM charts –example designs

Impediments to Synchronous design: Clock Skew, Gating the clock, Asynchronous inputs,.
Synchronizer Failure and Metastability: Synchronizer failure, Metastability Resolution Time, Reliable Synchronizer Design, Analysis of Metastable timing , Better synchronizers, Metastable hardened flip flops , Synchronizing High Speed data transfers
Timing hazards : Static Hazards, Finding static hazards, Dynamic Hazards, Designing hazard free circuit

Module 3: Designing With Programmable Devices (6 hours)

Programmable LSI Techniques - Programmable Logic Arrays - Programmable Array Logic - Sequential PLDs - Sequential Circuit Design using PLDs - Complex Programmable Logic Devices and Filed Programmable Gate Arrays - Altera Series FPGAs and Xilinx Series FPGAs

Module 4: Design Issues For Testability (10 hours)

Introduction to Testing and Diagnosis
Fault modeling : Logical fault models - Fault Detection and Redundancy - Fault Equivalence and Fault Location - Fault Dominance - Single stuck model - Multiple stuck model - Bridging faults
Design for Testability: Testability -Ad hoc Design - Scan Registers and scan techniques -Boundary scan standards

Built in Self Test: Introduction - Test Pattern generation -Generic Off line BIST Architectures Compression Techniques -General aspects -Signature Analysis

References:

1. J. Bhasker; A VHDL Primer, Pearson Education, 2000
2. John F Wakerley ,Digital Design Principles and Practice –4th Edition , Pearson education ,2006
3. Charles H Roth ,Jr , Digital Design using VHDL , Cenage Publishers ,India Edition,2006
4. Kenneth L Short , VHDL for Engineers , Pearson Education ,2009
5. Mark Zwolinski ,Digital System Design with VHDL –Pearson Education,2004
6. Miron Abramovici, Melvin Breuer, Arthur D Friedman ,Digital Systems Testing and Testable Design –Jaico Publishing House,2005
7. Miron Abramovici, Melvin Breuer, Arthur D Friedman Digital Systems Testing and Testable Design –

EC6102: Embedded System Design

Pre-requisite: Nil

L	T	P	C
3	0	3	4

Course Outcomes:

- ***CO1***: *Understanding the basic idea regarding the nature of embedded systems including mathematics and signal processing.*
- ***CO2***: *Understanding the hardware and software aspects of modern embedded systems including sensors and actuators for practical systems.*
- ***CO3***: *Analyzing the needs of society and develop systems to satisfy these needs.*
- ***CO4***: *Learning the nature of embedded system design as is done in a product design industry and do practical work on it.*
- ***CO5***: *Understanding the latest trends in embedded systems design.*

Total Hours: 42 Hrs Theory + 42 Hrs Lab

Module 1: (8 hours)

Introduction to Embedded system, Embedded system examples, Parts of Embedded System Typical Processor architecture, Power supply, clock, memory interface, interrupt, I/O ports, Buffers, Programmable Devices, ASIC,etc. Simple interfacing examples. Memory Technologies – EPROM, Flash, OTP, SRAM,DRAM, SDRAM etc.

Module 2: (10 hours)

Concept of System on chip.
Introduction to Cypress Programmable System on Chip (PSoC). Structure of PSoC, PSoC Designer, PSoC Modules, Interconnects, Memory Management, Global Resources, Design Examples

Module 3: (10 hours)

ARM architecture, ARM organization and Implementation, Memory Hierarchy, ARM Instruction Set and Thumb Instruction set, Assembly Language Programming, High- Level Language Programming, System Development using ARM.

Digital Signal Processing on ARM.

Peripheral Programming and system design for a specific ARM processor (ARM7/9).

Module 4: (14 hours)

Embedded System product Development Life cycle (EDLC), Specifications, Component selection, Schematic Design, PCB layout, fabrication and assembly. Product enclosure Design and Development. Concept of firmware, operating system and application programs. Power supply Design. External Interfaces.
Embedded System Development Environment – IDE, Cross compilation, Simulators/Emulators, Hardware Debugging. Hardware testing methods like Boundary Scan, In Circuit Testing (ICT) etc.
Bus architecture like I^2C, SPI, AMBA, CAN etc.

Laboratory experiments will be based on PSoC and ARM development Kits.

References:

1. Shibu K.V. Introduction to Embedded Systems Tata McGraw Hill, 2009
2. Tim Wilmshurst, An introduction to the design of small-scale embedded systems Palgrave
3. Robert Ashby Designer's Guide to the Cypress PSoC Newnes (An imprint of Elsevier), 2006
4. Oliver H. Bailey, The Beginner's Guide to PSoC Express Timelines Industries Inc.
5. Van Ess, Currie and Doboli Laboratory Manual for Introduction to Mixed-Signal, Embedded Design, Alphagraphics, USA
6. Steve Furber ARM System-on-chip Architecture ,Second Edition Pearson Education,2007
7. William Hohl ARM Assembly Language Programming CRC Press,2009
8. Andrew Sloss,Dominic Symes, Christ Wright, ARM System Developer's guide –Designing and optimizing software Elseiver Publishers ,2008
9. Web Based Resources

EC6201: Basics of VLSI

Pre-requisite: Nil

L	T	P	C
3	0	3	4

Course Outcomes(Theory component)

- ***CO1****: Calculate various parameters of a MOSFET.*
- ***CO2****: Explain various short channel effects and explain their effects on circuit performance.*
- ***CO3****: Ability to design Transistor-Level CMOS Logic circuit for a given functionality.*
- ***CO4****: An ability to estimate timing characteristics, noise margins, power consumption of a digital VLSI circuit.*
- ***CO5****: Analyze Gate Function and Timing Characteristics of a multi input CMOS Logic gates.*
- ***CO6****: Estimate timing of a complex VLSI circuit using Logical Effort analysis.*
- ***CO7****: To identify reasons for delay in a VLSI gate/circuit and apply various techniques to reduce delay of gate/circuit.*
- ***CO8****: Design static CMOS and dynamic clocked CMOS circuits.*
- ***CO9****: Draw layout of a CMOS circuit*
- ***CO10****: Identify and explain the role of parasitic elements in a CMOS digital circuit*
- ***CO11****: To compare various logic design styles on their performance metrics (speed, power consumption, area)*
- ***CO12****: Analyze working of SRAM cell and DRAM cell*

Course Outcomes(Laboratory component)

- ***CO1****: An ability to extract MOSFET parameters through simulations.*
- ***CO2****: An ability to design and simulate CMOS circuit with given specifications.*
- ***CO3****: Effect of process circuit performance.*
- ***CO4****: Pre-layout and post layout simulations and parasitic extraction.*
- ***CO5****: Draw a layout of a CMOS circuit, and analyze the circuit timing using a simulator.*
- ***CO6****: Simulate static CMOS and dynamic clocked CMOS circuits.*
- ***CO7****: Ability to summarize various findings.*
- ***CO8****: Ability articulate a technical report.*
- ***CO9****: Design a circuit of choice (Project).*

Total Hours: 42 Hrs Theory + 42 Hrs Lab

Module 1 (11 hours)
Introduction MOSFET, threshold voltage, current, Channel length modulation, body bias effect and short channel effects, MOS switch, MOSFET capacitances, MOSFET models for calculation-Transistors and Layout, CMOS layout elements, parasitics, wires and vias-design rules-layout design SPICE simulation of MOSFET I-V characteristics and parameter extraction

Module 2 (10 hours)
CMOS inverter, static characteristics, noise margin, effect of process variation, supply scaling, dynamic characteristics, inverter design for a given VTC and speed, effect of input rise time and fall time, static and dynamic power dissipation, energy & power delay product, sizing chain of inverters, latch up effect-Simulation of static and dynamic characteristics, layout, post layout simulation

Module 3 (13 hours)

Static CMOS design, Complementary CMOS, static properties, propagation delay, Elmore delay model, power consumption, low power design techniques, logical effort for transistor sizing, ratioed logic, pseudo NMOS inverter, DCVSL, PTL, DPTL & Transmission gate logic, dynamic CMOS design, speed and power considerations, Domino logic and its derivatives, C2MOS, TSPC registers, NORA CMOS – Course project

Module 4 (8 hours)

Circuit design considerations of Arithmetic circuits, shifter, CMOS memory design - SRAM and DRAM, BiCMOS logic - static and dynamic behaviour -Delay and power consumption in BiCMOS Logic

References:

1. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits - Analysis & Design, MGH, Third Ed., 2003
2. Jan M Rabaey, Digital Integrated Circuits - A Design Perspective, Prentice Hall, Second Edition, 2005
3. David A. Hodges, Horace G. Jackson, and Resve A. Saleh, Analysis and Design of Digital Integrated Circuits, Third Edition, McGraw-Hill, 2004
4. R. J. Baker, H. W. Li, and D. E. Boyce,CMOS circuit design, layout, and simulation, Wiley-IEEE Press, 2007
5. Christopher Saint and Judy Saint, IC layout basics: A practical guide, McGraw-Hill Professional, 2001

EC6103: Analog & Data Conversion Systems

Pre-requisite: An Undergraduate course on Linear Integrated Circuits

L	T	P	C
4	0	0	4

<u>Course Outcomes:</u>

- ***CO1**: Learn and analyze various linear opamp circuits and noise analysis of the same.*
- ***CO2**: Learn the design aspects of Track and Hold amplifiers, Analog Multiplexers.*
- ***CO3**: Analyze typical DACs,ADCs.*
- ***CO4**: Familiarize with the design of Data Acquisition systems.*
- ***CO5**: Understanding the data sheets of various components and obtain basic knowledge of error analysis in different amplifiers.*

Total Hours: 56 Hrs

Module 1 (12 hours)
Linear op-amp circuits – Review of inverting and non-inverting configurations - current to voltage and voltage to current converters, current amplifiers, difference amplifiers - instrumentation amplifier, Input Offset Error Compensation in op-amp circuits, Op-amp noise, Noise Filtering, Noise in Photo diode amplifiers, Op-amp based First and Second order filters

Module 2 (12 hours)
Low input offset voltage opamps, low input offset current op-amps, low noise op-amps, precision – design, error budget, amplifier input errors, amplifier output errors, Signal conditioners with instrumentation auto-zero/chopper/isolation/charge amplifiers, Sample & Hold/Track & Hold Amplifiers, THA performance parameters, different types of THA, Analog Multiplexers – Examples, Designing of low power circuits for transducers.

Module 3 (18 hours)
Digital to analog converters -Accuracy, Resolution, Conversion speed, Offset error, Gain error, Integral and differential nonlinearity. Analog to digital converters- Track and hold errors, An overview of typical ADCs and DACs, ADCs and DACs for DSP Applications
Design of multi channel low level and high level data acquisition systems using ADC/DAC, SHA and Analog multiplexers.

Module 4: (14 hours)
Understanding and interpreting data sheets and specifications of various passive and active components, over voltage effects on analog integrated circuits - amplifier input stage over voltage, amplifier output voltage phase reversal, amplifier decoupling. Selection of amplifiers for data converters. Properties of a high quality instrumentation amplifier. Design issues affecting dc accuracy & error budget analysis in instrumentation amplifier applications. Selection of isolation amplifiers. AC errors in Data converters and dynamic performance. Selecting An A/D Converter. Analog Signal handling for high speed and accuracy. Error budget considerations for an electronic system. Testing of Data Converters, Data Converter Applications

References:

1. S Franco: Design with Operational Amplifiers and Analog Integrated Circuits,McGraw Hill, 3rd Edition,2002.
2. Paul Horowitz &Winfield Hill:The Art of Electronics, Cambridge University Press, 2nd

Edition, 1992

3. Jacob Baker R., Li H.W. & Boyce D.E., CMOS- Circuit Design, Layout & Simulation, PHI, 2000.
4. Walt Kester: Mixed-Signal and DSP Design Techniques, Newnes, Elsevier Science, 2003
5. Walt Kester: Analog-Digital Conversion, Analog Devices Inc, USA, 2004
6. Application Notes of ICs like AN-539, AD624

EC6104: DSP System Design

Pre -Requisite: A course on Digital Signal Processing

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1**: Familiarize with the needs of special digital signal processors.*
- ***CO2**: Obtain basic knowledge about the DSP processor architectures.*
- ***CO3** : Learn the design aspects of various DSP processors using different software tools.*
- ***CO4**: Acquire the current trends in digital signal processors with examples.*

Total Hours: 42 Hrs

Module 1 (8 hours)
Need for Special Digital Signal Processors, Processor trends: Von Newmann versus Harvard architecture, Architectures of superscalar and VLIW fixed and floating point processors, New Digital Signal Processing hardware trends, Selection of DS processors.

Module 2 (10 hours)
Introduction to a popular DSP from Texas Instruments (TMS330C6000 Series), CPU Architecture, CPU Data Paths and Control, Internal Data/Program Memory. On chip peripherals: Timers - Multi channel buffered serial ports - Extended Direct Memory Access, Interrupts, Pipelining.

Module 3 (11 hours)
Design aspects: Introduction to the C6713 DSK- Code Composer Studio IDE - Matlab and basic skills, Review of FIR filtering: FIR filter design techniques and tools, Review of IIR filtering: IIR filter design techniques and tools, Sampling, quantization and working with the AIC23 codec, Writing efficient code: optimizing compiler - effect of data types and memory map. TMS320C6713 Assembly language Programming: Instructions Set and Addressing Modes – Linear Assembly.

Module 4 (10 hours)
Current trends: Current trend in Digital Signal Processors: DSP Controllers - Architecture of TMS320C28XX series DSP and its applications. Architecture trends of other Texas Instruments DSP processors, Analog Devices DS processors: Introduction to Sharc/ Tiger Sharc/ Blackfin series, Other major vendors in the DSP market and the latest trends.

References:

1. On-line TI materials for the TI C6713 DSK board: http://www.ti.com
2. Naim Dahnoun Digital Signal Processing Implementation using the TMS320C6000 DSP Platform, 1st Edition
3. R. Chassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley and Sons, Inc., New York, 2004
4. Sen M. Kuo and Woon-Seng Gan.Digital Signal Processors: Architectures, Implementations, and Applications,
5. David J Defatta J, Lucas Joseph G & Hodkiss William S ;Digital Signal Processing: A System Design Approach, 1st Edition; John Wiley
6. Andrew Bateman, Warren Yates Digital Signal Processing Design, 1st Edition

7. A.V. Oppenheim and R.W. Schafer, Discrete-Time Signal Processing, Second edition, Prentice-Hall,Upper Saddle River, NJ, 1989
8. John G Proakis, Dimitris G Manolakis Introduction to Digital Signal Processing, 1st Edition.

EC6105: Electromagnetic Compatibility

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Course Outcomes:

- ***CO1**: Understand the importance of Electromagnetic compatibility in an electronic system design.*
- ***CO2**: Learn about EMC rules & regulations that a product designer should adhere to.*
- ***CO3**: Understand & analyze different EMC problems and their causes.*
- ***CO4**: Study different techniques used to solve various EMC problems.*
- ***CO5**: Study Design methods for PCBs which make it EM compatible.*
- ***CO6**: Practical assignments on EMC case problems and preparing reports.*

Total Hours: 56 Hrs

Module 1: (12 hours)

Need of Electromagnetic compatibility, Conducted Emission, Conducted Susceptibility, Radiated Emission, Radiated Susceptibility, Typical Noise Path, Methods of Noise Coupling, Decibels and Common EMC Units, Electrical Dimensions and Waves, Practical Experiences and Concerns, Non-ideal behavior of electronic components

Need of EMC Regulations -FCC Regulations- CISPR/IEC Regulations

Measurement of Radiated Interference- Open Area test Sites
Measurement of Conducted Interference – Line Impedance Stabilization Network (LISN).

Module 2: (14 hours)

Capacitive and inductive coupling, effect of shield on capacitive and inductive coupling, effect of shield on magnetic coupling, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, Shield Transfer Impedance - shielding properties of various cable configurations, coaxial cable and shielded twisted pair, braided shields, ribbon cables.

Safety grounds, signal grounds, single-point and multipoint-point ground systems, hybrid grounds, functional ground layout, practical low frequency grounding, hardware grounds, grounding of cable shields, ground loops, Common Mode Choke - shield grounding at high frequencies, guarded instruments.
Power Supplies – Linear and Switched Mode Power Supplies – Effect of Power supply components on conducted emission, Power supply Filters, Power supply and Filter Placement, Power supply Decoupling, Driving Capacitive Loads, High Frequency Filtering, System bandwidth.

Module 3: (14 hours)

Near fields and far fields, characteristic and wave impedances, shielding effectiveness, absorption and reflection loss, shielding with magnetic material, apertures, conductive gaskets, conductive windows, conductive coating, grounding of shields.

Electrical Bonding – Shape and Material for Bond Strap, General Guidelines for Good Bonds

EMC Components – EMI suppression Cables, EMC connectors, EMC Gaskets, Isolation Transformers, Opto-Isolators

Digital Circuit Noise and layout – Frequency versus Time Domain, Digital Logic Noise, Internal Noise Sources, Digital Circuit Ground Noise, Power Distribution, Noise Voltage Objectives, Measuring Noise Voltages, Unused Inputs, Logic Families.

Module 4: (12 hours)

Transmission lines, reflections and termination

System Design for EMC – Printed Circuit Board Design, System Configuration and Design

Electrostatic Discharge (ESD) - Static generation, human body model, static discharge, ESD protection in equipment design, Transient and Surge Protection Devices, software and ESD protection, ESD versus EMC, ESD Testing

References:

1. Henry W.Ott: Noise Reduction Techniques in Electronic Systems Second Edition Wiley Interscience Publication
2. Clayton R.Paul :Introduction to Electromagnetic Compatibility Second Edition Wiley Interscience Publication
3. V. Prasad Kodali Engineering Electromagnetic Compatibility- Principles, Measurements, Technologies, and Computer Models Second Edition IEEE Press
4. Ralph Morrison Grounding and Shielding circuits and interference 5th edition Wiley interscience (IEEE press) Publication

EC6106: Electronic System Design Laboratory

Pre-requisite: Nil

L	T	P	C
0	0	3	2

<u>Course Outcomes:</u>

- ***CO1****: Conduct survey/market study to obtain the requirements of a new product.*
- ***CO2****: To apply knowledge acquired in electronic system design courses in practical scenario.*
- ***CO3****: Acquire working knowledge of several electronic components and integration of these components to form a final product.*
- ***CO4****: Provide exposure to all stages of a product design.*

Total Hours: 42 Hrs

This lab contains the design of a complete Electronic system, which takes the student through all the steps of an electronic product, which include:

- Requirements/market study
- Specifications
- Component selection
- Schematic Entry
- Layout Design
- Mechanical Design
- Assembly
- Testing.

EC6107: DSP System Design Laboratory

Pre-requisite: Nil

L	T	P	C
0	0	3	2

Course Outcomes:

- ***CO1***: *Obtain the ability to apply knowledge of signal processing in various real-time applications.*
- ***CO2***: *Familiarize with embedded design using code composer studio.*
- ***CO3***: *Design real-time signal processing operations using code composer studio.*
- ***CO4***: *Implementation of the time constrained functions using assembly code.*
- ***CO5***: *Interfacing of multimedia data to DSP starter kit.*

Total Hours: 42 Hrs

Introduction to C-based Embedded Design Using Code Composer Studio, and the TI 6713 DSK: Familiarization of creating, building, and testing some simple projects in the Code Composer Studio (CCS) integrated development environment (IDE), familiarization of some of the debugging, profiling, and visualization tools available within the CCS IDE, Explore the I/O capabilities of the DSK - LEDs DIP switches, AIC23 Audio Codec

Design of Filter in CCS Using C: Implementation of real-time finite impulse response (FIR) filtering and infinite impulse response (IIR) filtering on the TMS320C6713.

Fourier Transform: Implementation of DFT, FFT programs using CCS, Implementation of FFT Applications using DSP - DTMF Tone Generation and Detection.

Implementation of the time constrained functions using assembly code, Comparison of implementation of functions using C and assembly.

Interfacing of multimedia data to the 6713 DSK, Real-Time Processing.

EC6121: Electronic Packaging

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1***: *Understand the basic knowledge of functions of an electronic package, the packaging hierarchy and the driving forces on packaging.*
- ***CO2***: *Understand the design of electronic package through a multidisciplinary approach like electrical, thermal, material, reliability and testability design.*
- ***CO3***: *Learn about various IC assembly technologies.*
- ***CO4***: *Learn about electronic board assembly, design and development.*
- ***CO5***: *Conduct a study on trends in electronic packaging and give a presentation.*

Total Hours: 42 Hrs

Module 1: (12 hours)

Functions of an Electronic Package, Packaging Hierarchy, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high-density interconnect substrates,

Electrical Anatomy of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Design Process

Processing Technologies – Thin Film deposition, Patterning, Metal to Metal joining

Module 2: (10hours)

Design for Reliability – Fundamentals, Induced failures.

IC Assembly – Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging.

Discrete, Integrated and Embedded Passives.

Module 3: (10 hours)

Printed Circuit Board – Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards.

Board Assembly – Surface Mount Technology, Through-Hole Technology, Process Control and Design challenges.

Module 4: (10 hours)

Thermal Management for IC and PWBs, Cooling Requirements, Electronic cooling methods.

Electrical Testing – System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability.

References:

1. Rao R. Tummala : Fundamentals of Microsystem Packaging McGraw Hill.
2. Richard K. Ulrich &William D. Brown Advanced Electronic Packaging - 2nd Edition : IEEE Press

EC6122: Control System Design

Pre-requisite: A basic course on Control Systems

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1****: Understanding of classical analog control technique and its design.*
- ***CO2****: Understanding the basics of state space models and control system analysis and design using that.*
- ***CO3*** *:Understanding the basics of Digital Control systems.*
- ***CO4****: Understanding of analysis and design of Digital control systems using various techniques.*
- ***CO5****: Ability to compare different approaches in control systems and to choose an appropriate one for a given application.*

Total Hours: 42 Hrs

Module 1 (12 hours):

Review of basic elements of analog control systems- classical control techniques –transfer function approach- PID controller design - State-Space Models - Controllability and state transfer - Observability and state estimation - Pole Placement– State feedback approach

Module 2 (10 hours) :

Digital control systems -Sampling and reconstruction of signals – z transforms - pulse transfer function and analysis of digital control systems - discretization methods - Cascade and feedback compensation from continuous data controllers- Dead beat controller design

Module 3 (14 hours) :

Digital controllers - Root locus, Bode plot, Nyquist plot methods- Design of Digital PID controller – state space analysis of digital control systems - Observers and their use in state-feedback loops - Observer-based controllers - -controllability and observability under discretization

Module 4 (6 hours) :

Controller realization structures - canonical forms - Effects of finite word length on controllability and closed loop pole placement- Case studies

References:

1. Ogata, Discrete time control systems, Second Edition, Prentice Hall, 1995
2. Benjamin C Kuo, Digital Control Systems, Oxford University Press, 1992
3. Benjamin C Kuo, Automatic Control Systems, 7th Ed, Prentice Hall India,1995.
4. John Dorsey, Continuous & Discrete Control Systems, McGrawHill, 2002.
5. John J D’Azzo, Constantine H Houpis, Stuart N. Sheldon, Linear Control System Analysis & Design with MATLAB, 5th Ed, Marcel Dekker, 2003
6. Graham C Goodwin, Stefan F Graebe, Mario E Salgado, Control System Design, Prentice Hall India, 2003.

EC6123: Electronic Instrumentation

Pre-requisite: Nil

L	T	P	C
3	0	0	3

<u>Course Outcomes:</u>

- ***CO1***: *Understand the general principles of measurements such as standards, calibration, characteristics and errors.*
- ***CO2***: *Learn the different types of transducers and their characteristics in detail.*
- ***CO3***: *Study about the resistance transducers, inductive transducers and capacitive transducers and their applications.*
- ***CO4***: *Get knowledge about the techniques behind the measurement of voltage, current, power, resistance, etc., and the applications of instrumentation and logarithmic amplifiers.*
- ***CO5***: *Learn about the grounding, shielding , interferences, common signals etc., which affects the measurement system.*
- ***CO6***: *Understand the theory behind the latest display systems such as LCD, CRT, DSO, etc.,*
- ***CO7***: *To be able to design a stable and accurate measurement system by working together as a team.*

Total Hours: 42 Hrs

Module 1 (10 Hours)

General principles of measurements – Standards, calibration of instruments, Characteristics and errors in measurements.
Transducers – Basics of transducers, various types of transducers based on transduction principles, Active and passive transducers, Primary and Secondary transducers, Analog and Digital Transducers, Static and Dynamic responses, Sensitivity and Linearity Analysis, Transfer function analysis of various transducers and their associated circuits,

Module 2 (10 Hours)

Resistance transducers: Potentiometers, RTD and Thermistors, Strain gages, Hot wire anemometers and their applications in measurement of pressure, temperature etc. Inductive transducers: LVDT, Variable reluctance type, Synchro and their associated Circuits, Phase sensitive detector, Push-pull arrangement; Magnetostrictive transducers, Capacitance transducers: Construction and measuring circuits, Capacitance microphone.
Temperature measurement: Thermocouples and RTD: construction, installation and compensation; Semiconductor type temperature sensors; Radiation Pyrometers.
Piezoelectric transducers and its applications

Module 3 (12 Hours)

Measurement of voltage, current, power, noise, resistance, capacitance, inductance, time, frequency, charge pulse energy
Review of Instrumentation amplifiers, Logarithmic amplifiers and their applications.
Operating principles of Digital Multimeter. Voltage to current and voltage to frequency conversion.

Module 4 (10 Hours)

Ground Loop, Electromagnetic and Static pick up, Interference, Shielding and grounding, Floating Voltage measurements, Common Signals and their effect.

Display systems – Recorders, LCD, CRT, DSO etc.

Introduction to medical instrumentation, PLC – Development of ladder logic design and applications. Introduction to SCADA systems,

References:

1. Cooper W.D. Modern Electronics Instrumentation. PHI India, 1996
2. A,K, Sawhney: A course in Electical Electronic measurement and Instrumentation Dhanpatrai and sons, New Delhi 1999
3. Joseph J Carr: Elements of Electronic Instrumentation and Measurements: Pearson Education.
4. Ralph Morrison: Grounding and Shielding circuits and interfence - 5th edition – Wiley interscience (IEEE press) Publication

EC6124: Biomedical Instrumentation

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1**: Demonstrate a basic understanding of disease, medical conditions or physiological conditions.*
- ***CO2**: Understand the functional components of various instruments.*
- ***CO3**: Suggest a range of methods, which are used to diagnose, monitor or manage conditions.*
- ***CO4**: Demonstrate a critical appreciation of various biomedical instruments.*
- ***CO5**: To help students know general concepts of imaging system.*
- ***CO6**: Explore new developments for better management or assessment of conditions.*

Total Hours: 42 Hrs

Module I (12 hours)

Introduction to the physiology of cardiac, nervous & muscular and respiratory systems. Transducers and Electrodes: Different types of transducers & their selection for biomedical applications
The heart & the other cardiovascular systems. Measurement of Blood pressure, Blood flow, Cardiac output and cardiac rate. Electrocardiography, phonocardiography, Ballistocardiography, Plethysmography, Magnetocardiography. Cardiac pacemaker, catheterization, Defibrillators

Module II (10 hours)

Respiratory Mechanism, Measurement of gas volumes & flow rate. Carbon dioxide and Oxygen concentration in inhaled air. Respiratory controllers, Ventilators
Electroencephalograph, Electromyograph, Audiometers,

Module III (9 hours)

Heamodyalisis machines - function of the kidney - Artificial kidney - dialysers - membranes for hemodialysis, Measurement of pH value of Blood, ESR measurements, Haemoglobin measurements, Oxygen & carbon dioxide concentration in Blood. GSR measurements, polarographic measurements.

Module IV (10 hours)

X-ray machines, Digital Radiography, Computed Tomography, Nuclear Magnetic Resonance, MR Imaging: Principles and Techniques, Image characteristics, artifacts and applications. Physics of ultrasound imaging; Image quality and artifacts, Doppler Ultrasound, Uses in diagnosis. Radionuclide production, Radiation detection and measurements, Principle of Nuclear Imaging, Planar nuclear imaging

References:

1. R S Khandpur: Hand Book of Biomedical Instrumentation, TMH Publishing Company Ltd.
2. Geddes & Baker: Principles of Applied Biomedical Instrumentation, Wiley Interscience.
3. Leslie Cromwell: Biomedical Instrumentation and Measurements,Prentice Hall of India Pvt. Ltd
4. Cobbold R.: Transducers for Biomedical Instruments, John Wiley and Sons Inc.

EC6125: High Speed Digital Design

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1****: Compare the specifications and performance of various logic families used in digital design.*
- ***CO2****: To understand the propagation problems in lossy and loss less transmission lines in digital circuits and to design proper termination techniques for that.*
- ***CO3****: To understand the problems in power distribution networks and to design proper ones for digital circuits.*
- ***CO4****: To use signaling and coding techniques to improve signal integrity in high-speed links.*
- ***CO5****: Understanding the design of clock distribution techniques that ensure clock signal integrity.*

Total Hours: 42 Hrs

Module 1: Introduction to high-speed digital design (10 hours)

Frequency, time and distance - Capacitance and inductance effects - High seed properties of logic gates - Speed and power -Modelling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines - special transmission lines

Module 2: Power distribution and noise (10 hours)

Power supply network - local power regulation - IR drops - area bonding - onchip bypass capacitors - symbiotic bypass capacitors - power supply isolation - Noise sources in digital system - power supply noise - cross talk - intersymbol interference

Module 3: Signalling convention and circuits (10 hours)

Signalling modes for transmission lines -signalling over lumped transmission media - signalling over RC interconnect - driving lossy LC lines - simultaneous bi-directional signalling - terminations - transmitter and receiver circuits

Module 4: Timing convention and synchronisation (12 hours)

Timing fundamentals - timing properties of clocked storage elements - signals and events -open loop timing level sensitive clocking - pipeline timing - closed loop timing - clock distribution - syncronisation failure and metastability - PLL and DLL based clock aligners

References:

1. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
2. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
3. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996
4. Jan M, Rabaey, et all; Digital Integrated Circuits: A Design perspective, Second Edition, 2003

EC6126: Real Time Operating Systems

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1**: Get to know the basic concepts of operating Systems.*
- ***CO2**: Obtain practical knowledge in the use of sample Operating systems.*
- ***CO3**: Learn the various components in an OS.*
- ***CO4**: Learn to port an OS on a hardware and use it.*

Total Hours: 42 Hrs

MODULE 1: (Introduction to Operating Systems)(10 Hours)
Introduction: Examples for embedded systems Design issues and trends Architectures of embedded systems, Software and operating systems Introduction to general operating systems concepts

MODULE 2: (10 HOURS)
Task Models and Metrics :Processes and tasks, various states of a task- multithreading .
Real-time tasks and scheduling, Timing-, precedence-, and resource constraints, Metrics for real-time systems, Classification of scheduling algorithms-
Aperiodic Task Scheduling: Non-preemptive methods ,Preemptive methods , Periodic Task Scheduling: Static priority assignments (RM, DM), Dynamic priority assignments (E Mixed Aperiodic and Periodic Tasks: Background scheduling,Static priority servers, Dynamic priority servers

MODULE 3: (10 HOURS)
Resource Access Protocols: Task Communications –pipes, mail boxes Task synchronizing: semaphores, priority inversion, deadlock, livelock

MODULE 4: (12 HOURS)
Structure of RTOS and kernel design issues- Examples of typical real time operating systems.

References:

1. Edward L Lamie :Real-Time Embedded Multithreading: Using ThreadX and ARM Cmp Books
2. Michael Barr and Anthony Massa: Programming Embedded Systems: With C and GNU Development Tools, 2nd Edition
3. Dr. K. V. K Prasad: Embedded Real Time Systems: concepts, design and programs ,
4. Chowdary Venkateswara Penumuchu Simple Real-time Operating System: A Kernel Inside View for a Beginner
5. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne. Operating System Concepts, 7th Edition Wiley Higher Education
6. Hermann Kopetz: Real-time systems: design principles for distributed embedded applications
7. Jane W.S. Liu: Real - Time Systems, Pearson Education, 2008

EC6127: Design For Manufacturability

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1**: To understand the concept that a product is to be designed in such a way that it is manufacturable and the advantages of such design.*
- ***CO2**: To understand the product manufacturing process, importance of manufacturer, different DFM rules and guidelines.*
- ***CO3**: To study about different types of PCBs and its design considerations for different applications.*
- ***CO4**: To understand about different design rule checks in PCB design.*
- ***CO5**: To understand design for manufacturability in case of integrated circuits design.*

Total Hours: 42 Hrs

Module 1 (Introduction) (10 Hours)

Product Life cycle – Introduction, Growth, Mature and Saturation, Product life cycle management, What is DFM, Need of DFM – Higher Quality, Lower Cost, Faster Time to market, better Yield etc. Designer vs manufacturer

Need for different DFM techniques for different companies – Different applications, Different manufactures, Different equipment and processes. Development of DFM rules, Design Guidelines, exceptions.

Simple assembly process vs complex and expensive components, Simple component manufacture vs complex manufacturing process, Simple and inexpensive design vs expensive and complex service and support.

Module 2 (Design For Manufacturing -PCB) (12 Hours)

PCB Design and manufacturing process. Design considerations for different types of PCBs – Single layer PCBs, Multilayer PCB, Flexible PCB etc. Design considerations for PCBs for different applications – Digital circuits, Analog circuits, High speed circuits, Power circuits etc.

Layout rules and parameters. Design rule checks – Signal layer checks, Power/Ground checks, Solder mask check, Drill check etc.

Manual verification – Thermal design, plane split width, isolation, PCB thickness etc.

Automated processes, Through Hole vs SMT technologies.

Module 3 (Design For Manufacturing -IC) (12 Hours)

Miniaturization and increased complexity of VLSI circuits Functional Yield, Parametric Yield, Reliability, Yield Loss Modules, Yield analysis Higher Yield Cells, Spacing and Width of interconnect wires, Redundancy in the design, Fault Tolerant vias, generation of yield optimized cells, layout compaction, wafer mapping optimization, planarity fill, statistical timing

Module 4 (8Hours)

DFM softwares, Case Studies. Emerging manufacturing trends, Lead free design, standard design processes, Certifications. Over view of Design for Testability, Design for Assembly, Design for serviceability, Design for reliability etc..

References:

1. Michael Orshansky, Sani Nassif, Duane Boning Design for Manufacturability And Statistical Design: Constructive Approach,– Springer 2008
2. Chiang, Charles, Kawa, Jamil Design for Manufacturability and Yield for Nano-Scale CMOS,– Springer 2007
3. R S Khandpur :Printed Circuit Boards - Tata McGraw-Hill - 2005

EC6128: Advanced Processor Architectures

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1***: *Make a survey of advanced processors.*
- ***CO2***: *Understand the various advancements of the x86 architectures.*
- ***CO3***: *Compare the x86 architecture with that of other architectures.*
- ***CO4***: *Learn to port an OS on a hardware and use it.*

Total Hours: 42 Hrs

Module 1:Fundamentals [8 hours]

Technology trend -performance measurement –Comparing and summarizing performance-quantitative principles of computer design –Amdahl's law-Case studies.
History of the x86 family - Instruction Set architecture of a typical advanced x86 processor – using MASM32 for 32 bit assembly programming of x86 architectures

Module 2 [10 hours]
80386 to Pentium
Enhancements of 80386, Hardware Features, Protected virtual addressing mode -Virtual Memory, Memory Management Unit, Converting a Logical Address to a Physical Address, Calculating the size of the Logical Address Space, Protection, Multi Tasking, Interrupts of 80386, Privileged Instructions, The Enhanced Features of 80486, Data Alignment, The Pentium Processor, Pentium Pro, Pentium-II And Pentium-III, Pentium-IV, Latest Trends in Microprocessor Design

Module 3 [10 hours]
Instruction level parallelism - Instruction level parallelism and concepts-Branch prediction techniques-Overcoming data hazard and dynamic scheduling –dynamic scheduling - examples and algorithm- Hardware based speculation-The VLIW approach for exploiting ILP - The microarchitecture of Pentium- Limitations of ILP

Multithreading using ILP support to exploit thread level parallelism –Simultaneous multithreading –putting it all together,

Module 4 [14 hours]

Multiprocessor and thread level parallelism- Classification of parallel architecture- -Symmetric shared memory architecture-simultaneous thread level parallelism-cache coherence protocols-distributed shared memory architecture-directory based cache coherence protocol- synchronization –putting it all together in the Sun T1 processor Pipelining: Issues and solutions

References:

1. Hennesy J. L. & Pattersen D. A., Computer Architecture: A Quantitative approach, 4/e, Elseiver Publications, 2007
2. Lyla B.Das The x86 Microprocessors –Architecture Programming and Interfacing -8086 to Pentium, Pearson Education , 2010 .

3. Pattersen D. A. & Hennesy J. L., Computer Organisation and Design: The Hardware/ Software Interface, 3/e, Elseiver Publisher John Shenn ,Modern Processor Design: Fundamentals of Superscalar Processors (McGraw-Hill series in Electrical Engineering)
4. Jurij Silc, Borut Rob c, Theo Ungerer .Processor Architecture –From DataFlow to Super scalar and Beyond

EC6129: Analog and Digital Filter Design

Pre-requisite: An undergraduate course on Signals and systems

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1**: Understand the design of Analog filters.*
- ***CO2**: Learn the basics and design of active filters.*
- ***CO3**: Learn the basic forms of FIR filters, and how to design filters with desired frequency response.*
- ***CO4**: Understand the process of quantization in digital filters.*
- ***CO5**: Apply engineering problem solving strategies to DSP problems.*

Total Hours: 42 Hrs

Module 1 (9 hours)

Filter approximations: Butterworth, Chebychev, Bessel and Elliptic approximations to ideal low pass filter characteristics – Frequency transformations to obtain HPF, BPF and BEF from normalized prototype LPF – Delay equalizer, Sensitivity - Definition and basic properties - Function sensitivity - Coefficient sensitivity - Q and ω_o sensitivity

Module 2 (13 hours)

Basics of Active Filter Synthesis: RC-Op-Amp circuits, Biquad circuits based on negative feedback and positive feedback topologies; Active networks based on passive ladder structures; filter realizations with gyrator, Effects of real Op-Amps on active filters, active and passive compensation, Higher order filter realizations, Circuit implementation and practical design considerations taking into account the input dynamic range and output signal-to-noise ratio.

Module 3 (12 hours)

Digital Filter Design: Design of digital filters based on continuous-time filters,mapping of differentials, impulse invariant transformation, modified impulse invariant transformation, bilinear transformation, matched z-transform technique, Padé approximation, Prony's method, Shank's method, spectral transformations for digital filters. Design techniques for linear phase FIR filters: (a) windowing method, (b) frequency sampling, (c) weighted Chebyshev approximation

Module 4 (8 hours)

Quantization Effects in Digital Filters: Review of binary representation of numbers, truncation and rounding, coefficient quantization, roundoff noise, interaction of roundoff noise and dynamic range, scaling for parallel and cascade forms, limit-cycle oscillations, state-space structures, error spectrum shaping via feedback.

References:

1. Gobind Daryanani: 'Principles of Active Network Synthesis & Design', John Wiley, 1978
2. A S Sedra and P O Brackett: 'Filter Theory and Design: Active and Passive', Matrix Publishers, 1978
3. M E Van Valkenberg: 'Analog Filter design', Oxford University Press, 1995
4. Leland B. Jackson: Digital Filters and Signal Processing, Kluwer Academic,Boston,MA, 3rd edition, 1996.

5. Lawrence R. Rabiner and Bernard Gold: Theory and Application of Digital Signal Processing, Prentice-Hall of India Pvt. Ltd., New Delhi, 1975.
6. Andreas Antoniou: Digital FiltersAnalysis, Design, and Applications, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2nd edition, 1993

EC6130 Hardware Software Co-Design

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1***: *To understand the basics of hardware software co design of embedded systems and its models and tools used for this.*
- ***CO2***: *To understand the concept of hardware software partitioning during product architecture design.*
- ***CO3***: *To study about interfacing hardware and software and it's verification.*
- ***CO4***: *To study about interfacing of the designed product with external hardware and software.*
- ***CO5***: *To apply the learned concepts in some specific design examples, and the familiarizatio of industry approaches in hardware software co-design.*

Total Hours: 42 Hrs

Module 1: (12 hours)

Introduction – Review of Embedded system concepts, Design of Embedded System Overview of Hardware software co design framework. Components of co-design process Models and representations – co-design models and languages, Co-Design Finite State Machine (CFSMs), Synchronous Languages, Overview of ESTEREL Language, Modeling software CFMs, Software cost model, Processor characterisation model.

Synthesis- Partioning and Architecture selection, Hardware and Software synthesis, Software cost estimation.

Module 2: (12 hours)

Interface synthesis, Real Time operating system synthesis, Interfacing hardware and software, Target specific parts, scheduling specific parts, common parts, schedule validation

Verification – Rapid prototyping, simulation and co-simulation, simulation as partinioing support, High-Level co-simulation using VHDL, formal verification

Module 3: (8 hours)

Interfacing to external hardware and software – external hardware, external software, Interfacing to an external RTOS.

Module 4: (10 hours)

Design Examples – Dashboard controller, Automatic bus controller, Shock absorber controller.

Industry approaches to hardware software co-design, Overview of Chinook, COSYMA, Ptolemy, POLIS etc. Recent trends

References:

1. Balarin, F., Giusto, P., Jurecska, A., Passerone, C., Sentovich, E., Tabbara, B., Chiodo, M.,Hsieh, H., Lavagno, L., Sangiovanni-Vincentelli, A., Suzuki, K. Hardware-Software Co-Design of Embedded Systems - - Springer 1997
2. Staunstrup, Jørgen, Wolf, Wayne :Hardware/Software Co-Design: Principles and Practice - - Springer, 1997

EC6131: Advanced Circuit Analysis

Pre-requisite: An undergraduate course on Electric Circuit Analysis

L	T	P	C
3	0	0	3

Course Outcomes:

- ***CO1****: Understand Network topology*
- ***CO2****: Explore Theorems of Tellegen and Minty and The Implicit Duality Theorem*
- ***CO3****: Learn Multiport Decomposition of Networks.*
- ***CO4****: Understand the concepts of Linear and quadratic Programming*

Total Hours: 42 Hrs

Module 1: (10 hours)

Network topology: Matrices associated with graphs, the short circuit and open circuit operations, their generalization through the use of ideal transformers and vector space operations corresponding to these operations.

Module 2: (10 hours)

Theorems of Tellegen and Minty: Formal equivalence, areas of applications. The Implicit Duality Theorem and its applications

Module 3: (12 hours)

Multi port decomposition, ideal transformer resulting from the connection of ideal transformers, adjoint networks and systems, networks with decomposition methods based on altering network topology

Module 4: (10 hours)

Ideal diode, ideal transformer, resistor circuits and their relation to Linear and Quadratic Programming.

References:

1. S.Seshu and M.B.Reed, Linear Graphs and Electrical Networks, Addison Wesley, 1961.
2. H.Narayanan, Submodular Functions and Electrical Networks, Annals of Discrete Maths, vol-54, North Holland,1997.

EC7101: Project

Pre-requisite: Nil

L	T	P	C
-	-	-	20

<u>Course Outcomes:</u>

- ***CO1***: *Understanding the technology needs of the world.*
- ***CO2***: *Refresh the basics of engineering so as to understand the new technology.*
- ***CO3***: *Be proficient in hardware and software tools.*
- ***CO4***: *Understand the relevance of new thoughts and technology for society and the world.*

Syllabus:

The duration of major project is for two continuous semesters from third. The project can be analytical work, simulation, hardware design or a combination of these in the emerging areas of Electronics and Communication Engineering under the supervision of a faculty from the ECE Department. Project work has be carried out individually. The PG evaluation committee of the department shall evaluate the project during the third and fourth semesters.

EC6108: Seminar

Pre-requisite: Nil

L	T	P	C
0	0	2	1

Course Outcomes:

- ***CO1***: *Understanding the new trends and latest research topics.*
- ***CO2***: *Refresh the basics of engineering so as to understand the new technology.*
- ***CO3***: *Learn the art of presentation ,documentation and writing of technical matter.*
- ***CO4***: *Understand the relevance of new thoughts and technology for society and the world.*

Syllabus:

Each student shall present a seminar in the eighth semester on a topic relevant to Electronics and Communication Engineering for about 30 minutes. The topic should not be a replica of what is contained in the syllabus. The topic shall be approved by the Seminar Evaluation Committee of the Department. The committee shall evaluate the presentation of students. A seminar report in the prescribed form shall be submitted to the department after the approval from the committee.