DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Structure and Syllabi for Pre Ph.D Programme

SUBJECT – 1

S.No	Course Code	Title of the Course
1	24CMGT01T	Research Methodology

SUBJECT - 2

S.No	Course Code	Title of the Course
1	24CMGT02T	Research and Publication Ethics

SUBJECT – 3

Choose any **one** subject from the following list

S.No	Course Code	Title of the Course
1.	24CECE01T	Image & Video Processing
2.	24CECE02T	Digital Signal Processors and Architectures
3.	24CECE03T	Embedded Real Time Operating Systems
4.	24CECE04T	Advanced Embedded Processor Architecture
5.	24CECE05T	Digital System Design
6.	24CECE06T	VLSI Technology and Design
7.	24CECE07T	Advanced Data Communications
8.	24CECE08T	Antenna Measurements

SUBJECT – 4

Choose any **one** subject from the following list

S.No	Course Code	Title of the Course
1.	24CECE09T	Image Processing and Computer Vision
2.	24CECE0AT	Biomedical Imaging Systems
3.	24CECE0BT	Real Time Concepts for Embedded Systems
4.	24CECE0CT	Microcontrollers for Embedded system Design

5.	24CECE0DT	Digital IC Design
6.	24CECE0ET	Micro Electronics
7.	24CECE0FT	Wireless Communications &Networks
8.	24CECE0GT	Microwave Antennas

Title of the Course	IMAGE AND VIDEO PROCESSING
Program	Ph.D
Branch	ECE
Course Code	24CECE01T

UNIT I : FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS: Basic steps of Image Processing System Sampling and Quantization of an image – Basic relationship between pixels Image Transforms: 2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Wavelet Transforms:Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT II: IMAGE PROCESSING TECHNIQUES: IMAGE ENHANCEMENT: Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters,Sharpening spatial filters.Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening,Selective filtering.
Image Segmentation: Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region Based segmentation.

UNIT III: IMAGE COMPRESSION: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy& Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, JPEG Standards.

UNIT IV: BASIC STEPS OF VIDEO PROCESSING: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models,Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT V: 2-D MOTION ESTIMATION: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, and Mesh basedMotion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

PRESCRIBED TEXT BOOKS:

1. Digital Image Processing – Gonzaleze and Woods, 3rd ed., Pearson.
2. Video processing and communication – Yao Wang, JoemOstermann and Ya–quin Zhang. 1st
3. Ed., PH Int.

REFERENCE BOOKS :

1. Digital Video Processing – M. Tekalp, Prentice Hall International

Title of the Course	DSP PROCESSORS AND ARCHITECTURES
Program	Ph.D
Branch	ECE
Course Code	24CECE02T

UNIT 1: INTRODUCTION TO DIGITAL SIGNAL PROCESSING: Introduction, A Digital signal processing system, the sampling process, discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time – invariant systems, Digital filters, Decimation and interpolation.

UNIT 2: COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATIONS: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational error, D/A Conversion Errors, Compensating filter.

UNIT 3: ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT 4: PROGRAMMABLE DIGITAL SIGNAL PROCESSORS: Commercial Digital signal processing Devices, Data Addressing modes of TMS320C54XXDSPs, Data Addressing modes of TMS320C54XX Processors, memory space of TMS320C54XX Processors, Program Control TMS320C54XX instructions and Programming, On – Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIV 5: INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/ O, Direct memory access (DMA).

PRESCRIBED TEXT BOOKS:

1. Digital signal processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009.
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007.

REFERENCE BOOKS:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.

Title of the Course	EMBEDDED REAL TIME OPERATING SYSTEMS
Program	Ph.D
Branch	ECE
Course Code	24CECE03T

UNIT I: INTRODUCTION: Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read,write), Process Control (fork, vfork, exit, wait, waitpid, exec.)

UNIT II: REAL TIME OPERATING SYSTEMS: Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use

UNIT III: OBJECTS, SERVICES, AND I/O : Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

UNIT IV: EXCEPTIONS, INTERRUPTS AND TIMERS: Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT V : CASE STUDIES OF RTOS: RT Linux, Micro C/OS-II, Vx Works, Embedded Linux, Tiny OS and Basic Concepts of Android OS.

PRESCRIBED TEXT BOOKS:

1. Real-Time Systems-Jane W. S. Liu, Pearson Education.
2. Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers-Jonathan W. Valvano, CreateSpace Independent Publishing.

REFERENCE BOOKS:

1. Real-Time Concepts for Embedded Systems - Qing Li and Caroline Yao, CMP Books.
2. MicroC/OS-II: The Real-Time Kernel - Jean J. Labrosse, CRC Press.
3. Embedded Real-Time Systems Programming-Sriram V. Iyer and Pankaj Gupta, Tata McGraw Hill.
4. Operating Systems: Internals and Design Principles -William Stallings, Pearson.
5. Linux Device Drivers- Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman, O'Reilly Media.

Title of the Course	ADVANCED EMBEDDED PROCESSOR ARCHITECTURE
Program	Ph.D
Branch	ECE
Course Code	24CECE04T

UNIT I: ARM ARCHITECTURE AND CORTEX – M SERIES : Introduction to the ARM Cortex M4 and its targeted applications, ARM Cortex M4 architecture address space, on- chip peripherals (analog and digital) Register sets, addressing modes and instruction set basics.
ARM Cortex M4: I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers.

UNIT II: TIMERS, PWM AND MIXED SIGNALS PROCESSING: Introduction to Interrupts, Interrupt vector table, interrupt programming. Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, ADC. PWM Module & Quadrature Encoder Interface (QEI).

UNIT III: COMMUNICATION PROTOCOLS AND INTERFACING WITH EXTERNAL DEVICES: I2C protocol, SPI protocol, USB & UART protocol. Implementing and programming I2C, SPI, USB & UART interface.

UNIT IV: ARM CORTEX A ARCHITECTURE: Introduction to ARMv8-A, ARMv8-A Memory Management, ARMv8-A Memory Model, Caches and Branch Prediction, Synchronization and Cache coherency. Booting, Power Management, Virtualization, Security, Debugging.

UNIT V: DSP PROCESSORS: Architecture of TMS320CXX Processor – Addressing modes – Assembly language Instructions – Assembler directives, Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK on-board peripherals, – Code Composer Studio – Support Files - Application Programs for processing real time signals.

PRESCRIBED TEXT BOOKS:

1. Joseph Yiu, “The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors”, 2013, 3rd Edition, Newnes ,UK.
2. ARM Cortex-A Series Programmer‟s Guide for ARMv8-A Version: 1.0, 2015, ARM, United States.
3. James A Langbridge, “Professional Embedded ARM Development”, 2014,1st Edition, John Wiley Sons & Inc., United States.
4. Jonathan W. Valvono “Introduction to ARM Cortex-M Microcontrollers”, 2014, 5th Edition, Create Space Independent Publishing Platform, United States.
5. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley and

REFERENCE BOOKS:

1. Harris and Harris, Digital Design and Computer Architecture: ARM Edition, 2015, Morgan Kaufmann, , United States.
2. Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, 2015, 2nd Edition, E-Man Press LLC, United States.
3. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, CLI Private Limited, Delhi 2012.
4. B. Venkataramani and M. Bhaskar, Digital Signal Processors – Architecture, Programming and Applications – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.

Title of the Course	DIGITAL SYSTEM DESIGN
Program	Ph.D
Branch	ECE
Course Code	24CECE05T

UNIT I : PRINCIPLES OF COMBINATIONAL LOGIC: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions (Don‘t care terms) Simplifying Max term equations, Quine-McClusky techniques – 3 & 4 variables.

UNIT II: ANALYSIS AND DESIGN OF COMBINATIONAL LOGIC: Decoders, Encoders, Digital multiplexers, Adders and subtractors, Look ahead carry, Binary comparators.Programmable Logic Devices, Complex PLD, FPGA.

UNIT III: FLIP-FLOPS AND ITS APPLICATIONS: Basic Bistable elements, Latches, The master-slave flipflops (pulse-triggered flip-flops): SR flip-flops, JK flip-flops, Characteristic equations, Registers, binary ripple counters, and synchronous binary counters.

UNIT IV: SEQUENTIAL CIRCUIT DESIGN: Design of a synchronous counter,Design of a synchronous mod-n counter using clocked JK, D, T and SR flip-flops. Mealy and Moore models, State machine notation, Construction of state diagrams.

UNIT V: APPLICATIONS OF DIGITAL CIRCUITS: Design of a Sequence Detector, Guidelines for construction of state graphs, Design Example – Code Converter, Design of Iterative Circuits (Comparator), Design of Sequential Circuits using ROMs and PLAs,CPLDs and FPGAs, Serial Adder with Accumulator, Design of Binary Multiplier, Design of Binary Divider.

PRESCRIBED TEXT BOOKS:

1. John M Yarbrough,-Digital Logic Applications and Design, Thomson Learning,2001.
2. Donald D. Givone, ―Digital Principles and Design‖, McGraw Hill, 2002.
3. Charles H Roth Jr., Larry L. Kinney ―Fundamentals of Logic Design, CengageLearning, 7th Edition.

REFERENCE BOOKS:

1. D. P. Kothari and J. S Dhillon, ―Digital Circuits and Design‖, Pearson, 2016,
2. Morris Mano, ―Digital Design‖, Prentice Hall of India, Third Edition.
3. K. A. Navas, ―Electronics Lab Manual‖, Volume I, PHI, 5th Edition, 2015.

Title of the Course	VLSI TECHNOLOGY AND DESIGN
Program	Ph.D
Branch	ECE
Course Code	24CECE06T

UNIT I : INTRODUCTION TO VLSI: Applications of VLSI, Advantages, Integrated Circuit Manufacturing - Technology and Economics; CMOS Technology - Power consumption, Design and Testability, Reliability ; Integrated Circuit Design Techniques - Hierarchical Design, Design Abstraction and CAD; IP based design - types of IP, IP across design Hierarchy, IP Life cycle.

UNIT II : BASIC HDL CONSTRUCTS: VLSI Design flow, Overview of different modeling styles in VHDL, Data types, operators and data objects in VHDL, Dataflow Modeling, Behavioral Modeling, using VHDL for combinational Circuits and sequential Circuits.+`

UNIT III : HARDWARE DESCRIPTION LANGUAGE: Structural Modeling, Subprograms, Packages and Libraries, Generics, Configurations, attributes. Simple Test Bench, Simulation and Synthesis issues, case study of ALU/ Sequence Detector, Comparison of various Hardware Description Languages.

UNIT IV : PROGRAMMABLE LOGIC DEVICES: Introduction to CPLDs: Function block architecture, input/output block, switch matrix, Study of architecture of CPLDs of Altera /Xilinx. Introduction to FPGAs: Configurable logic block, input/output block and interconnect, Study of architecture of FPGAs of Xilinx /Altera.

UNIT V : CMOS CIRCUITS: Different logic families, MOS Transistor, CMOS as an inverter, propagation delay, power consumption/ dissipation issues, simple circuits using CMOS.

PRESCRIBED TEXT BOOKS:

1. Weste, Neil H.E., and David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Pearson Education, 2011.
2. John P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2002.
3. Michael D. Ciletti, Advanced Digital Design with the Verilog HDL, 2nd Edition, Pearson Education, 2011.

REFERENCE BOOKS:

1. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, 2nd Edition, Pearson Education, 2003.
2. Douglas J. Smith, HDL Chip Design: A Practical Guide for Designing, Synthesizing, and Simulating FPGA and ASIC Projects, 3rd Edition, Doone Publications, 2008.
3. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation, 3rd Edition, Wiley-IEEE Press, 2010.

Title of the Course	ADVANCED DATA COMMUNICATIONS
Program	Ph.D
Branch	ECE
Course Code	24CECE07T

UNIT I: INTRODUCTION: Introduction of data networks: network elements, protocols, and applications, Protocols: OSI reference model,Physical Layer and Access Network Technologies: SONET, DSL, cable, PON ATM Protocols and Services, Physical,ATM, and AAL layers: functions and PDU formats ATM services. Local Area Networks: Ethernet, Fast Ethernet, Switched Ethernet, Gigabit Ethernet, Access control protocol, Performance analysis

UNIT II: FRAME RELAY: Frame format and functions, congestion control. Point-to-Point Protocol: PPP format and operations, Packet over SONET, Multi-Protocol Label switching: MPLS protocol, forwarding and control components, MPLS fast- reroute, Pseudo-wire emulation

UNIT III: NETWORK LAYER: Internet Protocol Suite, Protocol model, Network layer protocols: IPv4, IPv6, ICMP, Transport layer protocols: TCP, UDP, RTP, Application protocols: Telnet, DNS, FTP, RTSP, HTTP, SNMP Internet Routing: Unicast routing protocols: RIP, OSPF, IS-IS, BGP, Multicast routing protocols: DVMRP, MOSPF,CBT, PIM,

UNIT IV: TRANSPORT AND HIGHER LAYERS: Router/Switch Design: Architectures: single stage, multi-interconnect network, Performance analysis: queuing delay and cell loss ratio

UNIT V: QOS AND TRAFFIC MANAGEMENT: QOS: QOS Protocols: IntServ/RSVP, DiffServ, MPLS, SBM, Queuing and scheduling disciplines, Congestion control techniques. Traffic Management: Network dimensioning, Call admission control, Usage parameter control/ Network parameter control, MPLS- Traffic engineering. Voice over IP: Codecs, Network architecture & protocols.

PRESCRIBED TEXT BOOKS:

1. Computer Networks: A. S. Tanenbaum, 4th Edution, PHI (For I, II and III)

REFERENCE BOOKS:

1. An engineering Approach to Computer Networking, S. Keshav, Person Edition.
2. Computer Networking a top – Down Approach Featuring the Internet, J. F. Kurose, K. W. Ross, PearsonEducation.

Title of the Course	ANTENNA MEASUREMENTS
Program	Ph.D
Branch	ECE
Course Code	24CECE08T

UNIT 1: INTRODUCTION TO ANTENNA MEASUREMENTS: Fundamentals of Antenna Measurements, Basics of Antenna Measurement Principles, Near-field and Far-field regions, Reciprocity principle in antenna measurements, Measurement Environment, Anechoic chambers and open-area test sites, Indoor vs. outdoor measurement setups

UNIT 2: MEASUREMENT TECHNIQUES FOR ANTENNA PARAMETERS: Radiation Pattern Measurements, Azimuth and elevation pattern measurement methods, 3D and polar pattern plotting, Gain and Directivity Measurement, Comparison method and gain-transfer method, Absolute gain measurement, Polarization Measurement, Co-polar and cross-polar discrimination

UNIT 3: ANTENNA IMPEDANCE AND BANDWIDTH MEASUREMENT: Impedance Measurement Techniques, Reflection coefficient and VSWR, Bandwidth Determination, Impedance bandwidth and its significance

UNIT 4: ADVANCED MEASUREMENT SYSTEMS: Near-Field Measurement Techniques, Planar, cylindrical, and spherical near-field measurements, Far-Field Measurement Techniques, Compact ranges and reflector antenna measurements, Modern Tools and Simulation Software, HFSS, CST Studio Suite, and MATLAB for antenna analysis

UNIV 5: ERROR ANALYSIS AND CALIBRATION IN MEASUREMENTS: Sources of Errors in Antenna Measurements, Instrumentation, alignment, and environmental factors, Calibration Techniques, Methods for minimizing systematic errors, Measurement Uncertainty Analysis, Quantifying and improving measurement precision

PRESCRIBED TEXT BOOKS:

1. C.A. Balanis, Antenna Theory: Analysis and Design, Wiley, Latest Edition.
2. Robert A. Sainati, CAD of Microstrip Antennas for Wireless Applications, Artech House.

REFERENCE BOOKS:

1. Principles of Planar Near-Field Antenna Measurements, Stuart Gregson, John McCormick, C. Parini, The Institution of Engineering and Technology (IET).
2. Antenna Measurement Techniques, H.W. Ehrenspeck and J.A. Murphy, Artech House.
3. Antenna Handbook, Y.T. Lo and S.W. Lee, Springer.
4. Microwave Engineering, David M. Pozar, Wiley.

Title of the Course	IMAGE PROCESSING AND COMPUTER VISION
Program	Ph.D
Branch	ECE
Course Code	24CECE09T

UNIT I: FUNDAMENTALS OF DIGITAL IMAGING: Digital Image Fundamentals, Light and Electromagnetic Spectrum, Components of Image Processing System, Image Formation and Digitization, Pixel Connectivity, Distance Measures

UNIT II: ADVANCED IMAGE ENHANCEMENT TECHNIQUES: Image Enhancements, Histogram Processing, Spatial and Frequency Domain Methods

UNIT III: IMAGE RESTORATION: Strategies Image Restoration, Noise Models, Restoration Techniques in Spatial and Frequency Domains

UNIT IV: COLOR PROCESSING AND SEGMENTATION: Color Image Processing, Image Segmentation, Edge Detection and Linking

UNIT V: COMPUTER VISION AND APPLICATIONS: Computer Vision, Feature Descriptors (HOG, SIFT, SURF), Object Detection and Tracking, Applications in Various Fields

PRESCRIBED TEXTBOOKS:

1. Digital Image Processing - Rafael C. Gonzalez and Richard E. Woods, 4th Edition, Pearson.
2. Fundamentals of Digital Image Processing- Anil K. Jain, PHI Learning.

REFERENCE BOOKS:

1. Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIPtools- Scott E. Umbaugh, 3rd Edition, CRC Press.
2. Image Processing, Analysis, and Machine Vision- Milan Sonka, Vaclav Hlavac, and Roger Boyle, Cengage Learning.
3. Computer Vision: Algorithms and Applications- Richard Szeliski, Springer.
4. Pattern Recognition and Image Analysis- Earl Gose, Richard Johnsonbaugh, and Steve Jost, PHI Learning.

Title of the Course	BIO-MEDICAL IMAGING SYSTEMS
Program	Ph.D
Branch	ECE
Course Code	24CECE0AT

UNIT I: INTRODUCTION TO SIGNALS: Time domain - Statistical and information theoretic analysis.Fourier spectrum of biosignals, short-time Fourier transform and spectrogram - DCT and its applications - Wavelet transform and time frequency analysis - Hilbert transform and its applications

UNIT II: TYPES OF ARTEFACTS AND NOISE: Time domain filters, frequency domain filters, notch and comb filters, optimal filtering, adaptive filters - Signal decomposition based filtering.

UNIT III: SIGNAL SEGMENTATION: Envelop extraction and analysis, temporal, spectral, statistical, information theoretic and cross spectral features - Waveform complexity

UNIT IV:LINEAR DISCRIMINATION: detection of motor activity from EMG, Harmonic analysis - Estimation of heart rate in ECG - Auto-regressive model - Estimation of spectrum of thoughts in EEG - Mmatched and Wiener filter for filtering in ultrasound.

UNIT V: VIRTUAL INSTRUMENTATION AND DATA ACQUISITION: Virtual instrument and traditional instrument, hardware and software-Building Graphical User interfaces for use in data acquisition - Graphical programming- Multi-channel data acquisition in LabVIEW

PRESCRIBED TEXTBOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, 2015, 2nd Edition, Pearson Education India, Bengaluru.
2. John G. Webster, “Medical Instrumentation Application and Design”, 2015, 4th Edition, John Wiley and sons, NewJersey.

REFERENCE BOOKS:

1. Robert H King, "Introduction to Data Acquisition with LabVIEW", 2012, 2nd Edition, McGraw Hill, NewYork.
2. Joseph Bronzino and Donal R. Peterson, Handbook of Biomedical Engineering, 2015, 4th Edition, CRC Press, Florida.

Title of the Course	REAL TIME CONCEPTS FOR EMBEDDED SYSTEMS
Program	Ph.D
Branch	ECE
Course Code	24CECE0BT

UNIT I: INTRODUCTION TO EMBEDDEDSYSTEM DESIGN : Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques -Designing with computing platforms – consumer electronics architecture –platform-level performance analysis.

UNIT II : ARM PROCESSOR AND PERIPHERALS : ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.

UNIT III : EMBEDDED PROGRAMMING: Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT IV: REAL TIME SYSTEMS: Structure of a Real Time System — Estimating program run times – Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronisation.

UNIT V: PROCESSES AND OPERATING SYSTEMS : Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real?time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes –Example Real time operating systems-POSIX-Windows CE. – Distributed embedded systems – MPSoCs and shared memory multiprocessors. – Design Example – Audio player, Engine control unit – Video accelerator.

PRESCRIBED TEXTBOOKS:

1. Embedded System Design: A Unified Hardware/Software Introduction-Frank Vahid and Tony Givargis, Wiley.
2. ARM System Developer's Guide: Designing and Optimizing System Software- Andrew N. Sloss, Dominic Symes, and Chris Wright, Elsevier.

REFERENCE BOOKS:

1. Embedded Systems: Architecture, Programming and Design-Raj Kamal, Tata McGraw Hill.
2. The Art of Designing Embedded Systems- Jack Ganssle, Elsevier.
3. Real-Time Systems: Theory and Practice- Rajib Mall, Pearson.
4. Computers as Components: Principles of Embedded Computing System Design-Marilyn Wolf, Elsevier.
5. Embedded Real-Time Systems Programming-Sriram Iyer and Pankaj Gupta, Tata McGraw Hill.

Title of the Course	MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN
Program	Ph.D
Branch	ECE
Course Code	24CECE0CT

UNIT I: 8051 MICROCONTROLLER: Microprocessors Vs Microcontrollers; Classification – bits, memory architecture, ISA; Little Endian Vs Big Endian. 8051 Architecture – Timers, Interrupts, Register Architecture (banks), PSW register, Memory architecture; Instruction set.

UNIT II: 8051 PROGRAMMING AND INTERFACES: Programming in C & Assembly for – Interrupts, Timers and Interfaces – PORTS, LED, ADC, SENSORS, LCD, DAC, and serial Communication.

UNIT III: ARM: ARM Design Philosophy; Overview of ARM architecture; States [ARM, Thumb, Jazelle]; Registers, Modes; Conditional Execution; Pipelining; Vector Tables; Exception handling.

UNIT IV: INSTRUCTION SET : ARM Instruction- data processing instructions, branch instructions, load store instructions, SWI instruction, Loading instructions, conditional Execution, Assembly Programming.
Thumb Instruction-Thumb Registers, ARM Thumb interworking, branch instruction, data processing instruction, single/multiple load store instruction, Stack instruction, SWI instruction, Assembly Programming.

UNIT V: ARM CORE BASED MICROCONTROLLER: Architecture of LPC214X, Memory Addressing, IO ports, Timers/counter, Watch Dog Timer, PWM, ADC/DAC, UART, Interrupts, Displays, C programming.

PRESCRIBED TEXT BOOKS:

1. Andrew N.Sloss, Dominic Symes, Chris Wright, ARM Developer‟s Guide, 2010, 1st Edition, Elsevier, United States
2. Kenneth Ayala, The 8051 Microcontroller & Embedded Systems Using Assembly and C, 2010, 1st edition, Cengage Learning, United States

REFERENCE BOOKS:

1. Steve Furber ARM System on Chip Architecture, 2010, 2nd Edition, Addison Wesley, United States
2. Technical Reference Manual CORTEX M-3, ARM, 2010.

Title of the Course	DIGITAL IC DESIGN
Program	Ph.D
Branch	ECE
Course Code	24CECE0DT

UNIT I: MOS DESIGN PSEUDO NMOS LOGIC: Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT II: COMBINATIONAL MOS LOGIC CIRCUITS: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates , AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

UNIT III :SEQUENTIAL MOS LOGIC CIRCUITS: Behavior of bi-stable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT IV : DYNAMIC LOGIC CIRCUITS: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT V :SEMICONDUCTOR MEMORIES: Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash MemoryNOR flash and NAND flash

PRESCRIBED TEXT BOOKS:

1. John P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2002.
2. Kamran Eshraghian, David A. Pucknell, Essentials of VLSI Circuits and Systems, Prentice-Hall, 2005.
3. R. Jacob Baker, CMOS Circuit Design, Layout, and Simulation, 3rd Edition, Wiley, 2010.

REFERENCE BOOKS:

1. Morris Mano, Digital Design, 5th Edition, Pearson, 2013.
2. Weste, Neil H.E., and David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Pearson Education, 2011.
3. Douglas A. Pucknell, Kamran Eshraghian, Basic VLSI Design: Systems and Circuits, 3rd Edition, Prentice-Hall, 2002.

Title of the Course	MICRO ELECTRONICS
Program	Ph.D
Branch	ECE
Course Code	24CECE0ET

UNIT I: ANALYSIS AND DESIGN OF SEQUENTIAL NETWORKS AND LOGIC FAMILIES: Analysis of clock sequential N/Ws, sequential parity checker, analysis of signal tracking & timing charts – state tables & graphs Review of combinational N/W design – design of N/W with limited gating Fan-in. Simulation & testing of logic N/Ws. Logic families: Performance analysis of DTL, DCTL, RTL, TTL, ECL logic families.

UNIT II: LINEAR ICS: DC effects & limitations of OP-amps, low frequency model of OP-AMP, input & output impedance, gain, noise, offset voltage & currents. Applications of OP-AMPs.

UNIT III: CMOS AMPLIFIERS AND DATA CONVERTERS: Building blocks for CMOS amplifiers, CMOS Transconductance amplifier, design of single ended telescopic, cascade, folded cascade & two stage amplifier. Frequency compensation scheme. Fundamentals of data converters, next rate A/D converters (Flash interpolating over sampled A/D & D/A converters

UNIT IV: DIGITAL ICS: CMOS open drain & Tri-state outputs. CMOS Transmission gate. Design using TTL 74XX & CMOS 40XX series of code converters, decoders, de-multiplexers, priority encoders, digital arithmetic operations, digital comparators & counters.

UNIT V: VLSI: Building blocks of digital design. Multiplexer, De-multiplexer, encoder, comparator, adder, ALU carry look ahead adder. FPGA Architectures: Channel type of FPGAs-Xlinx, Actel, Structured programmable logic, Altera, computational logic arrays, algotronix, VLSI primitives-bench mark.

PRESCRIBED TEXT BOOKS:

1. Operational amplifiers with linear integrated circuits by William D. Stanley LPE Fourth edition
2. Fundamentals of Logic Design By Charles H. Roth ,Jr.,Jaico publications,4Th Ed. 2006
3. The Art of Digital design by Processer & Winkel, Prentice Hall,1994.

REFERENCE BOOKS:

1. FPGAs: Old Field & DORF by Prentice Hall.
2. Analog MOS integrated circuits for Signal Processing by R.Gregorian & Temes.
3. Analog VLSI by Mohammed Ismail & Terri Fiez .McGraw-Hill,19994.

Title of the Course	WIRELESS COMMUNICATIONS & NETWORKS
Program	Ph.D
Branch	ECE
Course Code	24CECE0FT

UNIT I: WIRELESS COMMUNICATIONS & SYSTEM FUNDAMENTALS: Introduction to wireless communications systems, examples, comparisons & trends, Cellular concepts-frequency reuse, strategies, interference & system capacity, trucking & grade of service, improving coverage &capacity in cellular systems.

UNIT II: MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION: FDMA, TDMA, SSMA (FHMA/CDMA/Hybrid techniques), SDMA technique (AS applicable to wireless communications).Packet radio access-protocols, CSMA protocols, reservation protocols, capture effect in packet radio, capacity of cellular systems. Wireless Networking: Introduction, differences in wireless & fixed telephone networks, traffic routing in wireless networks –circuit switching, packet switching X.25 protocol. Wireless data services – cellular digital packet data (CDPD), advanced radio data information systems, RAM mobile data (RMD). Common channel signaling (CCS), ISDN-Broad band ISDN & ATM, Signaling System no .7 (SS7)-protocols, network services part, user part, signaling traffic, services & performance.

UNIT III: MOBILE IP AND WIRELESS APPLICATION PROTOCOL: Mobile IP Operation of mobile IP, Co-located address, Registration, Tunneling, WAP Architecture, overview, WML scripts, WAP service, WAP session protocol, wireless transaction, Wireless datagram protocol. Wireless LAN Technology Infrared LANs, Spread spectrum LANs, Narrow bank microwave LANs, IEEE 802 protocol Architecture, IEEE802 architecture and services, 802.11 medium access control, 802.11 physical layer.

UNIT IV: MOBILE DATA NETWORKS: Introduction, Data oriented CDPD Network, GPRS and higher data rates, Short messaging service in GSM, Mobile application protocol.

UNIT V: AD-HOC WIRELESS NETWORKS: Cellular and Adhoc wireless networks, applications, MAC protocols, Routing, Multicasting, Transport layer Protocols, quality of service browsining, deployment considerations, Adhoc wireless Internet.

PRESCRIBED TEXT BOOKS:

1. Wireless Communication and Networking – William Stallings, 2003, PHI.
2. Wireless Communications, Principles, Practice-Theodore, S.Rappaport, 2ndEdn. 2002, PHI.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE

REFERENCE BOOKS:

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
2. Telecommunication System Engineering – Roger L. Freeman, 4/ed., Wiley-Interscience, John Wiley & Sons, 2004.

Title of the Course	MICROWAVE ANTENNAS
Program	Ph.D
Branch	ECE
Course Code	24CECE0GT

UNIT 1: INTRODUCTION TO ANTENNA PARAMETERS: Introduction, Antenna Parameters, Radiation Patterns, Radiation Power Density, Radiation Intensity, Gain, Antenna, Efficiency, Bandwidth, Polarization, Input Impedance, Antenna Radiation Efficiency, Antenna as aperture, Directivity and maximum Aperture, Friis Transmission Equation, Antenna Temperature.

UNIT 2: REFLECTOR ANTENNAS: Number Plane Reflector, Corner Reflector, 90° Corner Reflector, Other Corner Reflectors, Parabolic Reflector, Front-Fed Parabolic Reflector, Cassegrain Reflectors, Lens Antennas, Lenses with $n>1$, Lenses with $n<1$, Lenses with Variable Index of Refraction.

UNIT 3: ANTENNA ARRAYS: Introduction, Two Element Array, N-Element Linear Array- Uniform amplitude and Spacing, Broadside Array, Ordinary End-Fire Array, Phased Array, Hansen-Woodyard End-Fire Array, N-Element Linear Array- Directivity, Non-uniform Amplitude, Binomial Array-Design equations.

UNIT 4: MICROSTRIP ANTENNAS: Introduction-Definition of Microstrip antenna, advantages and disadvantages of Microstrip antennas, applications, Radiation mechanism and Radiation fields of Microstrip antennas, excitation techniques.

UNIV 5: RECTANGULAR MICROSTRIP PATCH ANTENNAS: Introduction, Analysis of Rectangular patch radiators, the cavity model, Model Expansion Model, the transmission line model, Bandwidth Enhancement Techniques.

PRESCRIBED TEXT BOOKS:

1. Antennas by J.D. Kraus MC Graw-Hill, ISE, 1988.
2. Antenna theory analysis and Design by Constantine A. Balanis, John Wiley.

REFERENCE BOOKS:

1. Microstrip antennas by J.J. Bahl and Bhartia, Artech House, 1982.
2. Microwave Antenna – Theory and Design by Samuel Silver, IEE Press, London 1984.
3. Microstrip Antenna – Theory and Design by James J. Hall, P.S. Wood, 1981 Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI.