Autonomous Program Structure of Third Year B. Tech. Fifth Semester (Electronics and Telecommunication Engineering)

Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
20EC501	Digital Signal Processing	3	1	0	50	50	0	0	100	4
20EC502	VLSI Design	3	0	0	50	50	0	0	100	3
20EC503	Advanced Processors	3	0	0	50	50	0	0	100	3
20PEEC501	Programme Elective-I	3	0	0	50	50	0	0	100	3
20PEEC502	Programme Elective II*	3	0	0	50	50	0	0	100	3
20OEHS501	Open Elective I	3	0	0	50	50	0	0	100	3
20EC501L	Digital Signal Processing Lab	0	0	2	25	0	25	0	50	1
20EC502L	VLSI Design Lab	0	0	2	25	0	25	0	50	1
20EC503L	Advanced Processors Lab	0	0	4	25	0	0	25	50	2
20EC504L	Mini Project	0	0	2	25	0	25	0	50	1
20PEEC501L	Programme Elective Lab-I	0	0	2	25	0	0	25	50	1
20AC501	Audit Course : Self Expression	0	0	2	0	0	0	0	0	No Credit
	Total	**18**	**1**	**14**	**425**	**300**	**75**	**50**	**850**	**25**
	Grand Total	**33**			**725**		**125**			

***NPTEL / Swayam Course**

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Secretary Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

MKSSS's Cummins College of Engineering for Women, Karvenagar, Pune-411052

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Chairman Governing Body
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For Women, Pune-411052

Programme Elective-I			Programme Elective-I Lab		
Sr. No.	**Course Code**	**Course Title**	**Sr. No.**	**Course Code**	**Course Title**
1	20PEEC501A	Information Theory and Coding Techniques	1	20PEEC501LA	Information Theory and Coding Techniques Lab
2	20PEEC501B	Mechatronics	2	20PEEC501LB	Mechatronics Lab
3	20PEEC501C	Digital Image Processing	3	20PEEC501LC	Digital Image Processing Lab
4	20PEEC501D	Introduction to Internet of Things	4	20PEEC501LD	Introduction to Internet of Things Lab
Programme Elective-II*					
Sr. No.	**Course Code**	**Course Title**			
1.	20PEEC502	***NPTEL / Swayam Course**			

Open Elective I (Humanities)		
Sr. No.	**Course Code**	**Course Title**
1	20OEHS501A	Entrepreneurship Development
2	20OEHS501B	Intellectual Property Rights
3	20OEHS501C	Introduction to Digital Marketing
4	20OEHS501D	Law for Engineers
5	20OEHS501E	Organizational Behaviour
6	20OEHS501F	Project Management

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20EC501 DIGITAL SIGNAL PROCESSING

Teaching Scheme
Lectures: 3 Hours / Week
Tutorial : 1 Hour/ Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 4

Prerequisite:20EC302 Signals and Systems

Course Objectives:

1. To introduce basics of Digital Signal Processing (DSP), Analog to Digital and Digital to Analog conversion
2. To apply transform techniques for analysis of signals
3. To compare analog and digital filters and design digital filters
4. To understand practical DSP systems and their applications

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply sampling theorem to obtain discrete time signals and sampling rate conversion for Multirate DSP systems
CO2 Apply Discrete Fourier Transform and Short Time Fourier Transform on discrete time signals
CO3 Design and build FIR, IIR and Multirate digital filters
CO4 Analyze signals in frequency domain and performance of DSP algorithms
CO5 Design and simulate real-world applications of DSP

Unit I: Introduction to Digital Signal Processing (08)

Basic elements of Digital Signal Processing (DSP) and their requirement, Advantages of Digital over Analog Signal Processing, Sampling of analog signals, Sampling theorem in time domain, Recovery of analog signals, Mapping between analog to digital frequency, Block diagram representation of DT LTI systems: Direct form (I and II), Cascade form, Parallel form, Linear phase structure.

Unit II: Discrete Fourier Transform (09)

Overview of Discrete Time Fourier Transform (DTFT), Frequency domain sampling, Discrete Fourier Transform (DFT), Properties of DFT, Circular convolution, Computation of linear convolution using circular convolution, Decimation in Time (DIT) and Decimation in Frequency (DIF) Radix-2 FFT algorithms, Computational complexity of FFT algorithms, Bit-reversal, In-place computation, Introduction to Short Time Fourier Transform (STFT), Applications of FFT: Spectrum analyzer, Spectrum analysis of non-stationary signals.

Unit III: FIR Filter Design (08)

Ideal filter requirements, Comparison of analog and digital filters, Frequency response of Linear phase Finite Impulse Response (FIR) filters, Types of FIR filter, Design of linear phase FIR filter

using windowing method, Characteristics and comparison of different window functions, Finite word length effects in FIR filter design, Applications of FIR filter: Speech processing, Telecommunication systems.

Unit IV: IIR Filter Design (09)

Characteristics of ideal and practical frequency selective filters, Comparison of Butterworth, Chebyshev and Elliptic filters, Design of Infinite Impulse Response (IIR) filters from analog filters, IIR filter design by Impulse Invariance method, Bilinear Transformation, Frequency warping effect, Finite word length effects in IIR filter design, Applications of IIR filter: Biomedical Signal Processing, Image Processing.

Unit V: Multirate Digital Signal Processing (08)

Need of multirate systems, Interpolation by I factor, Decimation by D factor, Sampling rate conversion by I/D factor, Frequency domain analysis of multirate DSP system, Design of multirate filters, Polyphase implementation, Applications of multirate DSP: Audio systems, Sub-band coding.

Text Books:

1. John G. Proakis, D. G. Manolakis, **"Digital Signal Processing"**, *Pearson Prentice Hall*, (3rd Edition), (2007).
2. Emmanuel C. Ifeachor, B. W. Jervis, **"Digital Signal Processing–– A practical approach"**, *Pearson Education*, (2nd Edition), (2002).
3. S. Salivahanan, **"Digital Signal Processing"**, *McGraw Hill*, (3rd Edition), (2011).
4. Li Tan and Jean Jiang, **"Digital Signal Processing Fundamentals and Applications**", *Academic Press*, (2ndEdition), (2013).

Reference Books:

1. S. K. Mitra, **"Digital Signal Processing: A Computer Based Approach"**, *McGraw Hill*, (2nd Edition), (2013).
2. A. Nagoor Kani, **"Digital Signal Processing"**, *Tata McGraw Hill*, (2nd Edition), (2012).
3. Alan V. Oppenheim, **"Discrete-Time Signal Processing"**, *Pearson Education India*, (2nd Edition), (2013).
4. Vinay K. Ingale, John G. Proakis, **"Digital Signal Processing using MATLAB"**, *Cengage Learning*, (3rd Edition), (2009).

Online Resources:

1. http://freevideolectures.com/Course/2317/Digital-Signal-Processing-IIT-Delhi
2. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
3. NPTEL Course **"Digital Signal Processing and its Applications"**https://nptel.ac.in/courses/108/101/108101174/
4. NPTEL Course on **"Digital Signal Processing"** https://nptel.ac.in/courses/108/105/108105055/

20EC502 VLSI DESIGN

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite:20EC401 Digital Electronics

Course Objectives:

1. To introduce VLSI Design Flow
2. To explain the design hierarchy, syntax, lexical conventions, data types and modeling styles in Verilog
3. To illustrate the design and implementation of digital circuits using Verilog
4. To elaborate the FPGA architecture
5. To illustrate the design digital circuits using CMOS logic

Course Outcomes:
After completion of the course, students will be able to

CO1	Explain VLSI design flow
CO2	Design digital systems using Verilog HDL
CO3	Analyze the architecture of FPGA for logic synthesis
CO4	Realize digital circuits using CMOS logic

Unit I: Introduction to VLSI Design (07)
Philosophy of VLSI, Evolution of IC Technology (SSI to VLSI), VLSI Design flow, VLSI Based Integrated Circuit Architecture (Overview of Mobile SoC or Microcontroller SoC, logic, control, memory, interconnect, etc.), EDA Tools used in VLSI, VLSI Design Consideration, Application of VLSI IC.

Unit II: **Physical IC Design Flow (07)**
Hierarchical Modelling, Top-down and Bottom-up design methodology, Module Based Physical Design Flow, Floor-planning Steps, Netlist Binding, Timing and Clock Tree synthesis, clock net shielding, Power Planning, Routing and Design Rule Check, Parasitic Extraction, IC Fabrication process.

Unit III: Modeling Digital System using HDL (12)
Modules and Ports, Lexical conventions, Data types, System tasks, Compiler directives, Delay specification, Expressions, Operators, Operands in Verilog, Gate-Level Modeling, Modeling using basic Verilog gate primitives, Dataflow Modelling, Continuous assignments, Delay specification, Behavioral Modeling, Structured procedures, Initial and always, Blocking and non-blocking statements, Delay control, Conditional statements, Multiway branching, Loops, Sequential and parallel blocks, Task and function.

Unit IV: Design and Synthesis with FPGA (08)

Spectrum of PLD's, ASIC Vs FPGA Design flow, Architecture of FPGA, Programming Technologies, Dedicated Components in FPGA, Implementing logic in FPGA, Metastability, Specification and Application of FPGA, Design for synthesis, Synthesis of Case statement, Unintentional latch creation, Synthesis of if statement, Synthesis of Arithmetic components.

Unit V: Digital CMOS Circuit (08)

CMOS Inverter, Inverter VTC, Power Dissipation, Technology Scaling, MOSFET parasitic, Transmission gates, Lambda Design Rules, CMOS combinational logic design.

Text Books:

1. S. Palnitkar, **"Verilog HDL – A Guide to Digital Design and Synthesis",** *Pearson Publication*, (3rd Edition), (2010).
2. Neil H. E. Weste, David Money Harris, **"CMOS VLSI Design: A Circuit & System Perspective",** *Pearson Publication*, (4th Edition), (2010).
3. Pong P. Chu, "**FPGA Prototyping by Verilog Example: Xilinx Spartan3 Version**", *Wiley-Interscience*, (1st Edition), (2008).

Reference Books:

1. Jr. Roth, Charles H., Lizy Kurian John, Byeong Kil Lee, "**Digital System Design using Verilog**", *Cengage India Private Limited*, (1st Edition), (2017).
2. Wyane Wolf, **"Modern VLSI Design (System on Chip)",** *PHI Publication*, (3rd Edition), (2002).
3. Stephen Brown, Zvonko Vranesic, **"Fundamentals of Digital Logic with Verilog Design"**, *McGraw-Hill Education*, (3rd Edition), (2013).
4. Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim, "**CMOS Digital Integrated Circuits, Analysis and Design**" *McGraw Hill Education*, (4thEdition), (2019).

Online Resources:

1. NPTEL Course **"Hardware modeling usingVerilog"**https://nptel.ac.in/courses/106/105/106105165/
2. NPTEL Course **" CMOS Digital VLSI Design"**https://onlinecourses.nptel.ac.in/noc21_ee09/preview
3. https://www.udemy.com/course/vlsi-academy-physical-design-flow/

20EC503 ADVANCED PROCESSOR

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:

1. To introduce the architecture and features of ARM processor
2. To explain the applications of ARM based architecture
3. To interface I/O devices to ARM processor for real world applications
4. To explain hardware and software development tools

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain architecture of ARM core based processor
CO2 Develop algorithm and test the program for on chip peripheral of ARM based processor.
CO3 Develop algorithm and test the program for externally interfaced peripherals to the ARM based processor
CO4 Illustrate use of embedded operating system for CORTEX based processor and develop algorithm for the interfaced peripheral devices

Unit I: Introduction to ARM CORE (09)

ARM and RISC design philosophy, Introduction to ARM core and its versions, Multiple core concepts : dual, quad etc., ARM7, ARM9 and ARM11 features, Advantages and suitability in embedded applications, Registers : CPSR, SPSR, ARM7 data flow model, Programmers model, Modes of operations.

Unit II: Introduction to ARM7 Based Microprocessor (07)

ARM7 based processor: Features, Architecture (Block Diagram and Its Description), System Control Block (PLL and VPB divider), Memory Map, GPIO : Pin Connect Block (interfacing with LED), Serial communication programming for transmission and reception from computer, Programming for UART.

Unit III: On Chip Peripherals (06)

On chip ADC using with and without interrupt, On chip DAC for waveform generation, Interface EEPROM using I2C, LM35 sensor interface and calibration, Interrupts, Counters and Timers.

Unit IV: Real World Interfacing – External Peripheral Interface (06)

Interfacing of GSM, GPS, GLCD, KEYPAD, Bluetooth module, Wi-Fi module.

Unit V: ARM CORTEX (07)

Introduction to ARM CORTEX series, Improvement over classical series and advantages for embedded system design, CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, Need of operating system in developing complex applications in embedded system, Desired features of operating system and hardware

support from processor, Firmware development using CMSIS standard for ARM Cortex.

Unit VI: ARM Cortex based development Board (07)

Introduction of ARM Cortex based development board: Features and processor used. Installing different OS on ARM cortex based board and its booting sequence. Interface external peripheral devices.

Text Books:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, **"ARM System Developer's Guide-Designing and Optimizing Software"**, *Elsevier Publication*, (1st Edition), (2004).
2. Joseph Yiu, **"Definitive Guide to Arm Cortex-M23 and Cortex-M33 Processors"**, (1st Edition), (2020).

Reference Books:

1. Tammy Noergaard, **"Embedded Systems Architecture",** *Elsevier Publications*, (2nd Edition), (2004).
2. Dr. K. V. K. K. Prasad**, "Programming for embedded systems"**, *Wiley – Dreamtech India Pvt. Ltd*., (1st Edition), (2008).

Online Resources:

1. LPC 214x User manual (UM10139) :- www.nxp.com
2. LPC 17xx User manual (UM10360) :- www.nxp.com
3. ARM architecture reference manual: - www.arm.com
4. NPTEL course on, "**Embedded System Design with ARM",** https://onlinecourses.nptel.ac.in/noc20_cs15/preview
5. NPTEL course on, "**ARM based development",** https://nptel.ac.in/courses/117/106/117106111/

20PEEC501A INFORMATION THEORY AND CODING TECHNIQUES

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite:20BSEC301 Calculus and Probability, 20BS01 Linear algebra and Univariate Calculus

Course Objectives:

1. To introduce the basic concepts of information theory
2. To demonstrate channel capacity for types of channels
3. To explain source coding techniques for data compression
4. To demonstrate the error detection and correction capability of block codes, cyclic codes, BCH, RS codes and Convolution codes

Course Outcomes:
After completion of the course, students will be able to

CO1 Explain and measure entropy, mutual information and channel capacity for Channel models
CO2 Apply Shannon-Fano, Huffman and Lempel-Ziv technique for data compression
CO3 Analyse Hamming distance, error-correcting and error detecting capability for block codes, cyclic codes, BCH, and RS codes
CO4 Design and apply convolution encoding and decoding for error correction

Unit I: Information Theory and Source Coding (08)
Introduction to information theory, Entropy and its properties, Discrete memoryless channels and Mutual information, Source coding theorem, Huffman coding, Shannon-Fano coding, Lempel-Ziv algorithm, Run Length Encoding, Arithmetic coding.

Unit II: Information Capacity and Channel Coding (08)
Channel capacity, Discrete memoryless channel, Channel coding theorem, Information capacity theorem, Linear Block codes: Matrix description, Error detection and correction capability, Encoding and decoding circuit, Single parity check codes, Repetition codes, Hamming code and Interleaved code.

Unit III: Cyclic Codes (08)
Galois field, Primitive element, Primitive polynomial, Minimal polynomial and generator polynomial, Cyclic Codes: Encoding for systematic and non-systematic cyclic code, Syndrome decoding of cyclic codes, Circuit implementation of cyclic codes.

Unit IV: BCH and RS Codes (09)
Binary BCH code, Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes.

Unit V: Convolution Code **(09)**

Convolution code: Introduction of convolution code, Transform domain and Time domain approach, Graphical representation: State diagram, Tree diagram and Trellis diagram, Convolution decoding: Sequential and Viterbi.

Text Books:

1. Simon Haykin, Michael Moher, **"Communication Systems"**, *Wiley*, (5th Edition), (2009).
2. Ranjan Bose, **"Information Theory Coding and Cryptography"**, *Tata McGraw- Hill*, (3rd Edition), (2016).
3. Todd K. Moon, **"Error Correction Coding - Mathematical Methods and Algorithms"**, *John Wiley & Sons, Inc.***"**, (1stEdition), (2005)

Reference Books:

1. Bernard Sklar, **"Digital Communications fundamentals and Applications"**, *Prentice Hall P T R*, (2nd Edition), (2009).
2. Jorge Moreira, **"Patrick Farrell, "Essentials of Error-Control Coding"**, *John Wiley and Sons*, (1st Edition), (2006).

Online Resources:

1. NPTEL **"An introduction to Coding theory"**
   https://nptel.ac.in/courses/108/104/108104092/
2. NPTEL **"Error Control Coding: An Introduction to Convolutional Codes"**
   https://nptel.ac.in/courses/117/104/117104120/

20PEEC501B MECHATRONICS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20ES 01Basic Electrical and Electronics, 20EC301Electronics Circuit and Applications

Course Objectives:

1. To discuss the concepts and key elements of Mechatronics system
2. To explain principles and characteristics of Sensors and Transducers
3. To describe working principle of Hydraulic and Pneumatic systems and its applications
4. To give example of applications of Mechatronics Systems

Course Outcomes:

After completion of the course, students will be able to:

CO1 Classify , Compare and Explain functionality of components used to develop Mechatronics systems

CO2 Select specific component such as sensors/transducers and actuators used to develop Mechatronics systems

CO3 Analyze performance, approaches, procedures and results related to components used in Mechatronics System

CO4 Design signal conditioning circuit from the given components for specific task

CO5 Interface Hydraulics and Pneumatics circuit from the given components for specific task

CO6 Design a Mechatronics system for a given task

Unit I: Elements of Mechatronics Systems (07)

Introduction to Mechatronics, Key element/components, Level of Mechatronics system, Phases of Mechatronics design process, Integrated design approach, Advantages, and Disadvantages of Mechatronics systems, Mechanical components: Cam, Gears, Gear-train, Servomechanism and its application.

Unit II: Sensors and Transducers (12)

Overview of Sensors and Transducers, Classification and their Characteristics, Temperature measurement using Thermistor, RTD, Themocouple, Semiconductor (AD590, LM35, LM75), Force and Pressure measurement using Strain gauge, Load Cell, Piezoelectric, Differential Pressure Sensor, Displacement and Position measurement using Potentiometer, LVDT, RVDT, Proximity, Optical Encoder, Ultrasonic transducer, LDR and IR Sensors, Level and Flow measurement using Float Level, Capacitive Level sensor, IR Level Sensor, Ultrasonic transducer, Turbine type and Ultrasonic transducer, Vibration and acceleration measurement using Piezoelectric accelerometer, MEMS ICs.

Unit III: Signal Conditioning (08)

Signal conditioning: its necessity, Amplification, Filtering and Impedance Matching, Protection, 4-20mA Transmitters and receivers. Design of signal conditioning circuits for sensors and transducers.

Unit IV: Hydraulic and Pneumatic System (06)

Introduction to Hydraulic and Pneumatic Actuating system, Physical Components of Hydraulic and Pneumatic systems, Types of Actuators/Cylinders and their applications, Comparison of hydraulic and pneumatic systems, Pressure relief Valve, Pressure regulator valve and Directional Control Valve.

Unit V: Electric Actuators (05)

Selection criteria and specifications of stepper motors, DC motors, Servomotors, Solenoid valves, Solid State relays and Electromechanical relays, Electro-Pneumatic and Electro-Hydraulics Directional Control Valve, Driving circuit for electric actuators and interfacing with microcontrollers.

Unit VI: Mechatronics Systems Applications (04)

Mechatronics Systems in Automobile, Engine Management systems, Antilock Brake systems (ABS), Washing machine, Pick and place robot, Mobile robot, and Case studies on real life application.

Text Books:

1. Bolton W., **"Mechatronics - Electronic systems in Mechanical and Electrical Engineering"**, *Pearson Education Ltd.*, (6th Edition), (2016).
2. K. P. Ramachandran, G. K. Vijayaraghavan and M.S. Balasundaram, **"Mechatronics-Integrated Mechanical Electronic Systems"**, *Wiley Publication*, (1st Edition), (2008).
3. David Alciatore and Maichael B. Histand, **"Introduction to Mechatronics and Measurement Systems"**, *Tata McGraw Hill*, (4th Edition), (2013).

Reference Books:

1. Doeblin E.O., **"Measurement System-Application and Design",** *Tata McGraw Hill, New Delhi*,(4th Edition), (2004)
2. Mahalik N. P., **"Mechatronics - Principles, Concepts and Applications",** *Tata McGraw Hill, New Delhi*, (2th Edition), (2014)

Online Resources:

1. **NPTEL Course "Mechatronics"**
   http://nptel.ac.in/courses/112103174/
2. **NPTEL Course " Mechatronics"**
   https://nptel.ac.in/courses/112/107/112107298/

20PEEC501C DIGITAL IMAGE PROCESSING

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20BSEC301 Calculus and Probability. 20EC302 Signals and Systems.

Course Objectives:

1. To understand the basic concepts of image processing like relations between pixels, distance measures, statistical parameters, colour models, noise models and operations on images
2. To study different image enhancement, segmentation, representation and restoration techniques
3. To study image analysis in spatial and transform domains for image compression and filtering
4. To study different applications of Image processing

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain basic concepts of image processing, transform domain filtering, image restoration, color models and compression basics
CO2 Compute distance measures and perform arithmetic, logical, geometric, set and spatial transformation operations on images
CO3 Apply and analyze spatial domain image enhancement and compression techniques
CO4 Perform image representation, image segmentation and image classification techniques
CO5 Apply morphological operations on an image and select appropriate image processing modules to develop an image processing application

Unit I: Digital Image Fundamentals and Operations on Images (08)

Components of Image Processing System, Basic image processing classes, Element of Visual Perception, Sampling and Quantization, Relationship between pixels and Distance Measures, Statistical parameters, Basic operations on images, Morphological image processing, dilation, erosion, opening, closing.

Unit II: Image Enhancement (09)

Image Enhancement in Spatial Domain, Point, mask and global operations, Basic Gray Level transformations, Histogram, histogram equalization, Basics of Spatial Filtering, Smoothing, linear and non-linear filters, Sharpening filters, First and Second order derivatives, Image filtering in Frequency Domain, Low pass, High pass, Correspondence between Filtering in Spatial and Frequency Domain.

Unit III: Image Transforms and Colour Models (08)

Colour Image Processing, Colour Fundamentals, Colour Models, Pseudocolouring, Converting Colours to different models, Need for compression, Data Redundancies, Image Compression Model, Lossy and Lossless compression, 2-D Discrete Fourier Transform, Discrete Cosine Transform, JPEG compression.

Unit IV: Image Segmentation, Representation and Classification (09)

Image analysis, Detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, image representation, boundary representation by chain codes, Fourier descriptors, Shape number, Signatures, Types of classification algorithms, K-Nearest Neighbours, K-means, Decision Tree.

Unit V: Image Restoration and Applications of Image Processing (08)

Image restoration, Restoration model, Degradation causes, Noise models, Inverse filter, Weiner filter, Fingerprint recognition, Character recognition, Face recognition, Medical applications, Remote sensing, CBIR.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, "**Applications of Image Processing and Morphological Image Processing**", *Pearson Education*, (2nd Edition), (2012).
2. S. Jayaraman, Esakkirajan, Veerakumar, **"Digital Image Processing"**, *McGraw Hill Education*, (1st Edition,), (2012).

Reference Books:

1. Anil Jain, **"Fundamentals of Digital Image Processing"**, *Prentice Hall*, (1st Edition), (1989).
2. Pratt W. K**, "Digital Image Processing",** *John Wiley*, (2nd Edition), (2001).

Online Resources:

1. **NPTEL Course "Digital Image Processing"**
   http://nptel.ac.in/courses/117/105/117105135/
2. **NPTEL Course " Digital Image Processing"**
   https://nptel.ac.in/courses/117/105/117105079/

20PEEC501D INTRODUCTION TO INTERNET OF THINGS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20EC404 Embedded Systems

Course Objectives:
1. To explore various components of Internet of Things such as Sensors, internetworking and cyber space
2. To design Internet of Things circuits and solutions

Course Outcomes:
After completion of the course, students will be able to
CO1 Apply concepts to explain Internet of Things (IoT) architecture, protocols, models and devices used to develop IoT systems
CO2 Identify appropriate protocols, models and devices to develop IoT system
CO3 Compare and contrast IoT and M2M, IoT physical devices, networking and protocols techniques
CO4 Design IoT system for the given application

Unit I: Introduction to Internet of Things (07)
Internet of Things fundamentals: Sensing, Actuation, Internet of Things (IOT) Architecture and protocols: Communication Protocols, Sensor Networks, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Challenges in IOT, Communication models and APIs; IoT Enabling Technologies.

Unit II: Machine to Machine to Internet of Things (08)
The Vision-Introduction, From machine to machine (M2M) to Internet of Things (IoT), M2M towards IoT-the global context, Case study, Differing characteristics between M2M and IoT, Definitions, M2M Value Chains, Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards consideration, IoT Value Chains, Industrial IoT (IIoT).

Unit III: IOT Physical Devices and Objects (08)
Introduction to IoT tools, Implementation of IoT with Arduino and Raspberry-Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

Unit IV: IOT Networking and Addressing techniques (07)
RFID technology, Wireless Sensor Networks, IPv6 Protocol Overview, comparison of IPv4 and IPv6, IPV6 tunneling, IPsec in IPv6, Quality of Service in IPv6

Unit V: IOT Protocols and Cloud offerings (07)
IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, LoRaWAN, MQTT protocol, Introduction to cloud storage models and communication API's, web services for IoT.

Unit VI: Domain Specific Applications of Internet of Things (05)

Home automation - hardware approach - Industry applications, Surveillance applications.

Text Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** *Academic Press*, (1st Edition), (2014).
2. Vijay Madisetti and Arshdeep Bahga, **"Internet of Things (A Hands-on-Approach)",** *VPT* , (1st Edition), (2014).
3. Francis da Costa, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** *Apress Publications*, (1st Edition), (2013).
4. Cuno Pfister, "**Getting Started with the Internet of Things**", *O'Reilly Media*, (1st Edition), (2011).

Reference Books:

1. Honbo Zhou, **"The Internet of Things in the Cloud: A Middleware Perspective",** *CRC Press*, (1st Edition), (2012)
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), **"Architecting the Internet of Things",** *Springer*, (1st Edition), (2011)
3. Olivier Hersent, David Boswarthick, Omar Elloumi , **"The Internet of Things – Key Applications and Protocols",** (1st Edition), *Wiley*, (2012)

Online Resources:

1. NPTEL Course "**Introduction to IOT"**
   https://nptel.ac.in/courses/106/105/106105166/

20EC501L DIGITAL SIGNAL PROCESSING LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Oral: 25 Marks
Credits: 1

Course Objectives:

1. To apply sampling theorem on CT signals to find DT signals
2. To interpret the spectral representation of signals
3. To verify digital filter design and its performance
4. To perform sampling rate conversion on DT signals
5. To build programming skills for performing signal processing operations

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply sampling theorem and select the appropriate sampling to avoid aliasing
CO2 Develop programs to implement DFT and convolution operation
CO3 Analyze spectral representation of signals and window functions
CO4 Simulate the design of digital filters for given specifications, verify with theoretical results and analyze finite word length effects on design of digital filters
CO5 Demonstrate effect of sampling rate conversion

List of Experiments:

1. Verify sampling theorem and study aliasing effects.
2. Implement a function to find the DFT of a discrete time sequence.
3. Compute linear and circular convolution between sequences.
4. Analyze characteristics of different window functions.
5. Design FIR filter (LP/HP/BP/BS) for the given specifications using windowing method.
6. Design Butterworth filter using impulse invariance/bilinear transformation method.
7. Analyze effects of finite word length on performance of digital filters.
8. Apply sampling rate conversion (up-sampling/down-sampling) on discrete time signals and analyze the time and frequency domain effects.

20EC502L VLSI DESIGN LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Oral: 25 Marks
Credits: 1

Course Objective

1. To explore HDL based design approach
2. To simulate, synthesize and prototype design using PLD
3. To elaborate CMOS logic based design approach
4. To prepare layout using suitable CMOS process
5. To verify the DRC and simulate the layout for different performance parameter

Course Outcomes

After completion of the course, students will be able to

CO1 Model and simulate digital systems using Verilog HDL
CO2 Implement digital systems using suitable PLD
CO3 Design CMOS layout for given digital logic
CO4 Apply lambda rules to verify the designed layout

List of Experiments:

1. Model a Combinational circuit using Verilog HDL and implement it using PLD.
2. Model a Sequential circuit using Verilog HDL and implement it using PLD.
3. Model SRAM / FIFO using Verilog HDL and implement it using PLD.
4. Write a Verilog Code for LCD and interface it with PLD.
5. Design a layout for Inverter and Universal logic gates using selected CMOS technology.
6. Design a layout for Multiplexer using selected CMOS technology.
7. Design a layout for Boolean expression selected CMOS technology.
8. Design a layout for 1-bit RAM cell using selected CMOS technology.
9. Open Ended Assignment

20EC503L ADVANCED PROCESSOR LAB

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
ISE: 25 Marks
Practical :25 Marks
Credits: 2

Course Objective

1. To develop hardware interfacing skill
2. To develop software skill in embedded domain
3. To develop skill of designing embedded system using sensors
4. To explore cortex-based card size hardware system
5. To explore multicore programming

Course Outcomes:

After completion of the course, students will be able to

CO1	Apply software development tools for embedded processor based applications.
CO2	Develop algorithm and test program for on chip peripherals.
CO3	Develop algorithm and test program for externally interfaced peripheral devices.
CO4	Develop an Embedded application using simulation tool

List of Experiments:

1	Introduction to ARM development board and KEIL Micro vision - 5 IDE development tools.
2	Write a program to flash LEDs interfaced to GPIO.
3	Write a program to receive and transmit data on serial communication.
4	Interface GSM with ARM processor for sending and receiving messages, call connection.
5	Interface GPS to ARM processor and extract Latitude and Longitude from the string.
6	Write a program to generate waveform using on chip DAC.
7	Interface GLCD module to GPIO of ARM processor and write a program to display images.
8	Interface sensor to ADC and write a program to display calibrated data on LCD as well as serial port.
9	Write a program to toggle GPIO port with fixed time interval using on chip timer (without interrupt).
10	Write a program to toggle GPIO port with fixed time interval using on chip timer (with interrupt).
11	Install OS in Raspberry Pi. Write C Program and compile using GCC.
12	Interface LCD to Raspberry Pi.
13	Interface camera and write program to capture images and create video. OR Multi-core programming in Raspberry Pi.
14	Open ended assignment *

20EC504L MINI PROJECT

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Oral: 25 Marks
Credits: 1

Course Objectives:

1. Explain the Product Development Cycle through the mini project
2. Inculcate electronic hardware implementation skills by:
   a) Learning PCB artwork design using an appropriate EDA tool
   b) Learning soldering and effective trouble-shooting practices
   c) Understanding the significance of aesthetics and ergonomics while designing electronic products
3. Demonstration and Technical documentation of mini project in a team

Course Outcomes:

After completion of the course, students will be able to,

CO1	Identify and formulate a real life problem statement
CO2	Select an appropriate methodology to solve the identified problem
CO3	Design and validate the solution by using EDA tools
CO4	Estimate the time and cost budget required for developing the working model
CO5	Build a working model by analyzing / troubleshooting and testing the circuit in a team.
CO6	Draft a technical report, deliver a seminar and demonstrate/discuss the working model in a team

Guidelines:

1. Project group shall consist of not more than 3 students per group.
2. Project design ideas should be adopted from recent society/community based issues.
3. Application notes from well known component manufacturers may also be referred for designing.
4. Hardware components are mandatory.
5. Layout versus schematic verification is mandatory.
6. **Engineering Design Consideration(s) should be from one of these areas:-**

- Societal
- Environmental
- Ethical
- Health/Safety

Sustainability

Domains for projects may be from the following, but not limited to:

- Electronic Communication Systems
- Power Electronics
- Biomedical Electronics
- Audio, Video Systems
- Mechatronics Systems
- Embedded Systems
- Instrumentation and Control

Monitoring: (for students and teachers both)

Suggested Plan for various activities to be monitored by the teacher.

** Formation of groups of students. Students should interact with the community/stakeholders to Identify the problem statements.

Text Books:

1. Thomas C Hayes, Paul Horowitz, **"The Art of Electronics"**, *Cambridge University Press*, (3rd Edition), (2015).
2. Jim Williams, **"Analog Circuit Design: Art, Science and Personalities"**, *EDN series for Design Engineers*, (1st Edition), (2013).
3. M. Ashraf Rizvi, **" Effective Technical Communication"** ,*Tata McGraw Hill Education Pvt. Ltd.*, (1st Edition), (2005).

Reference Books:

1. A.E. Ward, Angus, **"Electronic Product Design",** *Stanley Thorne Publishers, UK*, (1st Edition) (1996).
2. Meenakshi Raman, Sangeeta Sharma, **"Technical Communication, Principles and Practice"**, *Oxford University Press*, (2nd Edition), (2012).
3. C. Murlikrishna, Sunita Mishra, **"Communication Skills for Engineers"**, *Pearson Education India*, (2nd Edition), (2011).
4. Kim Fowler, **"Electronic Instrument Design"**, *Oxford University Press*, (1st Edition), (2015).
5. Kimmo Karvinen and Tero Karvinen,**"Make: Arduino Bots and Gadgets",** *O' Reilly Media, Inc.*, (1st Edition), (2011).

Online Resources:

1. https://www.electronicsforu.com/
2. https://circuitcellar.com/category/article-materials-and-resources/
3. http://www.edn.com
4. Application notes of IC manufacturers

20PEEC501LA INFORMATION THEORY AND CODING TECHNIQUES LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Practical :25 Marks
Credits: 1

Course Objectives:

1. To determine entropy and channel capacity of noisy and noiseless channel
2. To explore source coding techniques for data compression
3. To develop the error detection and correction capability of block codes, cyclic codes, BCH, and RS codes.
4. To understand encoding and decoding of convolution codes

Course Outcomes:

After completion of the course, students will be able to

CO1 Develop program to calculate entropy, mutual information and channel capacity of noisy and noiseless channel
CO2 Develop program for source coding techniques for data compression
CO3 Develop program for error detection and correction linear block codes and cyclic codes
CO4 Develop program for channel performance improvement against burst errors with BCH codes
CO5 Simulate convolution encoding and decoding for error correction
CO6 Implementation of encoding and decoding of real life signals

List of Experiments:

1. Write a program for determination of various entropies, mutual information and compare channel capacity of channel Noise free channel, Binary symmetric channel and Noisy channel. (Programming in C)
2. Write a program for generation and evaluation of variable length source coding using Shannon – Fano coding and decoding / Huffman Coding and decoding / Lempel Ziv Coding and decoding
3. Implement algorithms for coding and decoding of Linear Block Code (LBC).
4. Implement algorithms for coding and decoding of Cyclic Codes.
5. Implement algorithms for Encoding with Convolution codes.
6. Implement algorithms for decoding of convolution codes.
7. Implement algorithms for encoding of BCH (Bose-Chaudhuri Hocquenghem) algorithm.
8. Mini project: Implementation of algorithms for encoding and decoding of real life signals

Note: - 3 to 7 simulation using MATLAB

20PEEC501LB MECHATRONICS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester : 25 Marks
Practical:25 Marks
Credits: 1

Course Objectives:

1. To Measure displacement, velocity, liquid level, liquid flow using sensors
2. To identify and interface components of electro-hydraulic/electro-pneumatic and hydraulic/pneumatic systems
3. To explore real life application of Mechatronics Systems

Course Outcomes:

After completion of the course, students will be able to

CO1 Measure load, velocity, flow and level using analog and digital sensors
CO2 Analyze characteristic and performance of sensors and actuators
CO3 Interface components of electro-hydraulic/electro-pneumatic and hydraulic/pneumatic to build circuits
CO4 Develop and demonstrate application of Mechatronics system using suitable hardware

List of Experiments:

1. Weight measurement using Load Cell.
2. Velocity and Angular Displacement measurement using optical encoder.
3. Liquid flow measurement using Turbine flow sensor.
4. Liquid level measurement using capacitance sensor.
5. Design of Signal Conditioning Circuit for Load Cell
6. Design 4 to 20mA current transmitter.
7. Interface hydraulic/ electro - hydraulic system component to actuate single acting and double acting cylinders.
8. Interface pneumatic/ electro-pneumatic system component to actuate single acting and double acting cylinders.
9. Design Mechatronics system for any application.

20PEEC501LC DIGITAL IMAGE PROCESSING LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical :25 Marks
Credits: 1

Course Objective

1. To practice the basic image processing techniques
2. To explore digital image enhancement techniques in spatial and transform domain
3. To understand image compression, colour model conversions, segmentation and restoration techniques
4. To explore the applications using image processing techniques

Course Outcome

After completion of the course, students will be able to

CO1 Perform basic operations and computations on images
CO2 Implement algorithms for image enhancement and image filtering
CO3 Perform image compression and colour model conversion
CO4 Apply image segmentation and restoration techniques
CO5 Develop an algorithm/application using various image processing techniques

List of Experiments: Matlab/Python

1. Perform basic operations on images (Create image/ operations/ distance measures).
2. Perform a) Histogram equalization b) Spatial domain filtering.
3. Perform a) DCT of an image b) Colour model conversion.
4. Perform Image segmentation (thresholding/region based) techniques
5. Perform Morphological operations on images / Wiener filtering.
6. Implement a Mini project (Application/algorithm) in image processing.

20EC501LD INTRODUCTION TO IOT LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
Practical:25 Marks
Credits: 1

Course Objectives

1. To learn use of sensors and actuators in IOT
2. To learn IOT devices and protocols
3. To build an IOT application

Course Outcome

After completion of the course, students will be able to

CO1 Select sensors and actuators in IOT application
CO2 Interface sensors and actuators with IoT development module
CO3 Develop a program to monitor and control by using web server
CO4 Develop an IOT system for given application

List of Experiments:

1. Introduction to various sensors and various actuators & its Application.
   a) PIR Motion Sensor.
   b) Float Sensor.
   c) Moisture Sensor.
   d) Temperature Sensor.
   e) Touch Sensor.
   f) Infrared Sensor.
   g) Servo Motor
   h) RFID Sensor
   i) Humidity sensor
2. Introduction to ESP32 and Arduino IDE/Visual Studio Code.
3. Write a program to measure sensor data and display on serial monitor.
4. Write a program to control Actuators.
5. Write a program to control Actuators based on real time sensor data.
6. Implement a standalone web server using of ESP32.
7. Develop a web application through ESP32.
8. Mini Project: Develop an IoT system for given application.