



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
ACCREDITED BY NAAC A+

I Year I- Semester	MTCS1101	L	T	P	C
		3	0	3	4.5
Advanced Digital Signal Processing					

Pre requisites: Signals and Systems, Random Variables & Stochastic Processes, Digital Signal Processing

Course Objectives:

1. To design and implement both Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters.
2. To understand the decimators and interpolators, including their roles and importance in digital signal processing.
3. To apply multi rate digital signal processing techniques to a variety of real-world applications.
4. To explore forward and backward prediction methods, demonstrating proficiency in solving normal equations associated with these techniques.
5. To learn the parametric and non-parametric approaches for power spectrum estimation.

Course Outcomes:

At the end of this course, students will be able to

1. Implement FIR and IIR digital filters, demonstrating the ability to apply theoretical knowledge.
2. Explain the concepts of multistage decimators and interpolators, including their significance in signal processing.
3. Apply the knowledge of multi rate digital signal processing for various applications.
4. Analyze the forward and backward prediction concepts and effectively solve the normal equations associated with these techniques.
5. Compare and evaluate parametric and non-parametric approaches for estimating power spectrum, discussing their advantages and limitations.

Unit I

Implementation of Digital Filters: Review of Filter Design Techniques, Basic Structures of FIR filter (Direct, Cascade, Polyphase, Linear Phase forms) and IIR filter (Direct, Cascade, Parallel forms), Lattice structure for FIR, Lattice and Lattice-Ladder structures for IIR filters.

Unit II

Multirate Digital Signal Processing: Basic principles, Decimators and Interpolators, Sampling Rate Conversion by a Rational Factor, Multistage Implementation of Sampling Rate Conversion.

Unit III

Applications of Multirate Digital Signal Processing: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Digital Filter Banks, Sub-band Coding of Speech Signals, Quadrature Mirror Filters, Trans-multiplexers, Over Sampling A/D and D/A Conversion.

Unit IV

Linear Prediction & Optimum Linear Filters:



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Random Processes, Rational Power Spectra, Relationship between Filter Parameters and Autocorrelation Sequence, Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the lattice forward and backward predictors. Solution of normal equations - Levinson-Durbin algorithm.

Unit V

Power Spectrum Estimation: Estimation of Spectra from Finite-Duration Observations of Signals, Non-parametric Methods for Power Spectrum Estimation-Bartlett, Welch methods. Parametric Methods for Power Spectrum Estimation- Relationship between Autocorrelation and Model Parameters, Yule-Walker method for AR model, MA model and ARMA model for power spectrum estimations.

REFERENCES:

1. J. G. Proakis and D. G. Manolakis "Digital Signal Processing: Principles, Algorithms, and Applications, 4th edition, Pearson Education India, 2007.
2. S. K. Mitra, "Digital Signal Processing: A Computer-based Approach", McGraw-Hill Higher Education, 4th edition, 2001.
3. P. Ramesh Babu, "Digital Signal Processing", Scitech Publications, 6th edition, 2015.
4. P. P. Vaidyanathan, "Multirate Systems and Filter Banks" Pearson Education India, 2006.
5. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.



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I Year I- Semester	MTCS1102	L	T	P	C
	ARM CONTROLLERS FOR EMBEDDED C PROGRAMMING	3	0	0	3

ARM CONTROLLERS FOR EMBEDDED C PROGRAMMING

COURSE OUTCOMES:

- CO1: Understand and analyze the design aspects. Architecture, and instruction set associated with ARM processors. Analyze the C programming optimization methods for ARM processor.
- CO2: Examines various cache-technologies that surround the ARM cores. Analyze the Memory Protection Units and Memory Management Units around ARM.
- CO3: Understand and analyze the design aspects. Architecture, and instruction set associated with ARM processors and Analyze the GPIO Pins, Interrupt handling, and Timers concepts in task execution.
- CO4: Apply the concepts of UART, ADC, and DAC to Peripherals.
- CO5: Design and implementation of embedded case study with serial protocols

UNIT I:

ARM Processor Fundamentals: ARM Design Philosophy, Registers, CPSR, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions. *ARM Processor families*

Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Load – Store Instructions, Software Interrupt Instruction, PSR Instructions.

Introduction to the Thumb Instruction Set: Thumb Register Usage, Branch Instructions, Data Processing Instructions, Load-Store Instructions, Stack instructions, Software Interrupt Instruction.

Efficient C Programming: Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Structure Arrangement.

Writing and Optimizing ARM Assembly Code: Writing Assembly Code, Profiling and Cycle Counting, Instruction Scheduling, Register Allocation, Conditional Execution, Looping Constructs.

UNIT II:

Exception and Interrupt Handling: Exception Handling, Interrupts, Interrupt Handling Schemes

Caches: The Memory Hierarchy and Cache Memory, Cache Architecture, Cache Policy, Flushing and Cleaning Cache Memory.

Memory Protection Units: Protected Regions, Initializing the MPU, Caches and Write Buffer.

Memory Management Units: Moving from an MPU to an MMU, How Virtual Memory Works, Details of the ARM MMU, Page Tables, Translation Lookaside Buffer, Domains And Memory Access Permission, The Fast Context Switch Extension

UNIT- III:

Introduction: Definition of Embedded Systems, Real life examples of embedded systems, Basics of Developing for Embedded Systems

ARM Instruction set Architecture: ARM Cortex-M Organization, Arithmetic, Logical and Shift instructions, Data Movement Instructions, Branch instructions, Program Status register, Bitwise logic operations, Sign and Zero extension, Data Comparison, Memory addressing, Branch and conditional execution, Control structures, Subroutines, 64-bit data processing.



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GPIO: GPIO Input Modes, GPIO Output Modes, Memory-mapped I/O, Push button, Programming exercises on GPIO and Push-button

General-purpose Timers: Clock Configuration, Timer Organization, and Counting Modes, Timer Update Events, PWM Registers, Configuration and initialization of PWM block, Programming exercises on the selection of clock source, Timer's concept, and PWM

UNIT-IV:

UART: UART Block, UART Registers, UART baud rate calculation, Configuration and initialization of UART

ADC/DAC: ADC & DAC registers, pin configuration, ADC modes, Configuring ADC and DAC module, Programming exercises on ADC and DAC

Interfacing: Keypad, LCD, and Seven segment display interfacing with ARM Cortex-M3 Microcontroller

UNIT-V:

Inter-Integrated Circuit (I²C): I²C operating modes, Configuration of I²C, Interface a sensor using I²C protocol

Serial Peripheral Interface (SPI): SPI Modes, Master operation, Slave operation, Configuration of SPI

Case Study: Smart Home-Smart Door Locks and Interface a temperature sensor with an I²C Module to measure the room temperature.

Text Books:

1. A.Sloss, D.Symes, C.Wright, "ARM system Developers Guide: Designing and Optimizing System Software", Morgan Kaufmann publishers, 2012.
2. Dr.Yifeng Zhu "Embedded Systems with ARM Cortex-M Microcontrollers in Assembly and C" Third edition, 2018

Reference Books:

1. Steve Furber, "ARM System on Chip Architecture", 2nd ed., Addison Wesley Professional, 2000.
2. Valvano, J., "Embedded microcomputer systems: real time interfacing", 3rd Edition, Cengage Learning, 2011.
3. Frank Vahid, TonyGivargis, "Embedded System Design", J Wiley India, 2005.
4. Ariel Lutenberg, Pablo Gomez, Eric Pernia "A Beginner's Guide to Designing Embedded System Applications on Arm Cortex-M Microcontrollers"
5. Qing Li, Caroline Yao "Real-time concepts for Embedded Systems" CMP books.

E-resources and other digital material

1. <https://nptel.ac.in/courses/106105193/>
2. <https://www.arm.com/resources/education/education-kits/efficient-embedded-systems>
3. https://www.keil.com/dd/docs/datashts/philips/lpc17xx_um.pdf
4. https://www.nxp.com/docs/en/datasheet/LPC1769_68_67_66_65_64_63.pdf
5. <https://www.nxp.com/downloads/en/schematics/LPCXpresso-LPC1769-CMSIS-DAP.pdf>

Michael J. Pont



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I Year I- Semester	MTCS1101	L	T	P	C
		0	0	2	1.5
Advanced Digital Signal Processing LAB					

Course Outcomes:

At the end of this course, students will be able to

1. Design and implement digital filters (IIR & FIR) using simulation software
2. Perform DFT transforms in time and frequency
3. Perform decimation and interpolation in both time and frequency domain
4. Apply parametric & non-parametric approaches to achieve power spectrum
5. Solve normal equation by the application of Levinson Durbin Algorithm

List of Experiments:

1. a) Generation of Discrete time signals and basic operations of discrete time signals
b) Analysis of Discrete time systems
2. Determine DFT and IDFT of a given sequence
3. a) Time domain representation of Decimator and Interpolator
b) CD data to DVD data conversion
4. Frequency domain representation of Decimator and Interpolator
5. Design of digital IIR Butterworth filters using frequency transformations
6. Design of digital IIR Chebyshev filters using frequency transformations
7. Cascade, Parallel and Lattice-Ladder realizations of digital filters
8. Design of FIR filters using various window techniques
9. Non-parametric method of power spectrum estimation
10. Parametric method of power spectrum estimation
11. Estimation of data series using Nth order forward predictor
12. Solution of normal Equation Using Levinson Durbin Algorithm



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I Year-I Semester	MTCS1103	L	T	P	C
		3	0	0	3
<p align="center">Radar Signal Processing (Professional Elective-1)</p>					

Course Outcomes:

1. Illustrate the operation of Radar and derive the radar range equation.
2. Know the characteristics of Matched filter for non-white noise.
3. Apply the various detection criterion and types of detectors that can be used to detect the Radar signals in noise.
4. Analyse the waveform design requirements and optimum waveforms for the detection of signals in clutter.
5. Justify the significance and types of pulse compression techniques in radar signals.

UNIT 1:

Introduction: Radar Block Diagram, Biostatic Radar, Monostatic Radar, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, MTI and Pulse Doppler Radar. Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation, Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver, Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.

UNIT 2:

Detection of Radar Signals in Noise: Detection Criteria – Nyman -Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors–Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection-CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management–Schematics, Component Parts, Resources and Constraints.

UNIT 3:

Waveform Selection : Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noise Like Waveforms, Waveform Design Requirements, Optimum Waveforms for Detection in Clutter, Family of Radar Waveforms.

U. V. Retm hami



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UNIT 4:

Pulse Compression in Radar Signals: Introduction, Significance, Types, Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression.

UNIT 5:

Phase Coding Techniques: Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar. Poly Phase Codes : Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM), Sidelobe Reduction for Phase Coded PC Signals.

TEXT BOOKS:

1. Radar Handbook - M.I. Skolnik, 2ndEd., 1991, McGraw Hill.
2. Radar Design Principles : Signal Processing and The Environment - Fred E. Nathanson, 2nd Ed., 1999, PHI.
3. Introduction to Radar Systems - M.I. Skolnik, 3rdEd., 2001, TMH.

REFERENCE BOOKS:

1. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.
2. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.



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I Year-I Semester	MTCS1105	L	T	P	C
		2	0	0	2
Research Methodology and IPR					

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation and analyze research related information
2. Follow research ethics and Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
3. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be Promoted among students in general & engineering in particular.
4. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
5. Applying AI Techniques to research Data

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 3

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and Databases, Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Unit 5

AI Tools for Research Methodology: Over view of AI tools for Data Collection, Analysis and evaluation in research, Introduction to AI techniques (Machine learning, Deep Learning , NLP) and selecting the right AI tool for specific research problem, Popular tools: Python(Pandas,scikit-learn, keras, NLTK),R and Tensor Flow

J. Inimishu



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TEXT BOOKS

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Research Papers on AI applications in academic Research, AI ethics guide
4. Tools: Python, Tensor Flow, NLP Libraries, AI powered literature Tools like Iris.ai.

REFERENCES

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

J. Minium Cunn



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I Year - I Semester	LAB-MTCS1106	L	T	P	C
		0	0	3	1.5
Embedded systems and IOT Lab					

Course Objectives:

- To Introduce Terminology, Technology and its applications.
- To Introduce Programming Languages like Python, C/C++, Embedded C
- To Introduce the Raspberry Pi platform, that is widely used in IoT Applications,
- To Introduce Arduino with different embedded applications.
- To Introduce the implementation of different sensors on IoT devices.
- To Introduce Node MCU with different applications

Embedded Systems Experiments: (Any 5 experiments from the following)

1. Study and Install IDE of Arduino and different types of Arduinos.
2. Interface LDR Sensor with Arduino for implementing Automatic Street light Controller.
3. Calculate the distance of the Object using Ultra Sonic Sound sensor with Arduino.
4. Calculate temperature using temperature sensor using Arduino.
5. Calculate Humidity Using Humidity Sensor using Arduino.
6. Interface the Bluetooth Module with the Arduino and control the LED by a Smartphone to turn it ON/OFF.
7. Interface IR Sensor with Arduino for detecting Obstacle.
8. Interface MQ-2 Gas Sensor with Arduino for detecting smoke

COMPONENTS/BOARDS/TOOL: Arduino Board / Arduino IDE**Internet of Things Experiments: (Any 5 experiments from the following)**

1. Getting started with Raspberry Pi, Install Raspbian on your SD card.
2. Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device.
3. Display a word on LCD. Interfacing with Raspberry Pi.
4. Using Raspberry Pi, Display Seven Segment.
5. Servo Motor Controlling with Interfacing using Raspberry Pi.
6. Soil Moisture detecting with soil moisture sensor using Raspberry Pi.
7. Calculate the distance using distance sensor using Node MCU.
8. Basic LED functionality using Node MCU.

COMPONENTS/BOARDS/TOOL: Raspberry Pi/Python Programming/Linux